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Enhancing the Quality of a Higher Education Course: Quality Function Deployment and Kano Model Integration

Bir Lisansüstü Dersin Kalitesinin Artırılması: Kalite Fonksiyon Göçerimi Yönteminin Kano Modeli ile Bütünleştirilmesi

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Özet

Küresel ekonomide özellikle gelişmekte olan ekonomiler için lisans eğitiminin kalitesi ile rekabet edebilirlik arasında önemli bir ilişki vardır. Kalite Fonksiyon Göçerimi (KFG), müşteri gerekliliklerini teknik gerekliliklere dönüştürmek için Toplam Kalite Yönetiminde (TKY) kullanılan önemli yöntemlerden biridir. Bu çalışmanın amacı, yükseköğretimde bir lisans dersinin kalitesini artırmak için müşterilerin ihtiyaçlarını belirlemek ve öncelik sırasına koymak için Batı tarzı, üçüncü nesil KFG yöntemini Kano modeli ile birlikte uygulamaktır. Bilinebildiği kadarıyla, literatürde belirtilen yöntemlerin yükseköğretim alanında birlikte kullanıldığı ampirik bir çalışmaya rastlanmamıştır. Yöntemlerin birlikte kullanılması sonucunda sadece en önemli öğrenci ihtiyaçlarını ve teknik ihtiyaçları içerecek şekilde bir odaklanmış kalite evi oluşturulmuştur. Sonuçlar, *tek boyutlu* ihtiyaçlar olarak da adlandırılan önde gelen öğrenci gereksinimlerinin, öğretim elemanının teorik ve sektörel bilgisi gibi çoğunlukla öğretim üyelerine yönelik özellikler olduğunu göstermektedir. *Cazip* ihtiyaçlar olarak adlandırılan teknik geziler ve davetli konuşmacılar gibi endüstri ile etkileşimin, öğrenci memnuniyetini artırdığı tespit edilmiştir. Odaklanmış kalite evine göre, öne çıkan teknik gereksinimler bütçe/fon, derse kayıtlı öğrenci sayısı, öğretim elemanının iş yükü, fabrika gezisi, iyi iletişim/empati, öğretim elemanının niteliği ve öğretim yeterliliği olarak bulunmuştur. Çalışmada önerilen bütünleşik çerçeve, eğitim kalitesini artırmak yönünde ana öğrenci gereksinimlerini tanımlamak ve karşılamak için eğitim alanındaki karar alıcılara katkı sunabilir.

Anahtar sözcükler: Ders kalitesi, kalite evi, kalite fonksiyon göçerimi, Kano modeli, yükseköğretim.

Abstract

There is an important relationship between the quality of undergraduate education and competitiveness in the global economy, especially for emerging economies. Quality Function Deployment (QFD) is one of the important methodologies in Total Quality Management (TQM) to translate customer requirements into technical specifications. The purpose of this study is to apply Third Generation Western QFD methodology together with Kano model to categorize and prioritize the needs of customers to increase a graduate-level course quality in higher education. To this end, the Voice of the Customer was identified through the Kano technique that enables categorization and prioritization of student requirements. To the best of our knowledge, this is the first empirical study in the literature that integrates the aforementioned methodologies in the field of higher education. With this integration, a focused quality house was generated which includes only prominent student and technical requirements. Accordingly, the prominent student requirements, which are classified as *one-dimensional* needs, are found to be the ones that are mostly lecturer-oriented attributes, such as the lecturer's theoretical and industrial knowledge. The interaction of the course with the industry, such as technical trips and invited speakers, which are called as *attractive needs*, are found to increase student satisfaction by creating delight. The prominent technical requirements are found to be budget/funds, number of students enrolled, lecturer workload, industry trip, good communication/empathy, lecturer qualifications, and competency in teaching. The combined framework may help educational decision-makers to identify and satisfy the main student requirements to enhance the quality of educational service processes.

Keywords: Course quality, higher education, house of quality, Kano model, quality function deployment.

Global competition has increased substantially not only in the business world but also in higher education. To catch up with the competition, higher education institutions focus on adapting to the developments in science and technology (Sagnak, Ada, Kazançoğlu, & Tayaksi, 2018). Quality has now become a key competitive weapon to serve and attract primary customers (e.g. students, parents) in education due to the challenge arising from the increasing

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number of institutions (Boonyanuwat, Suthummanon, Memongkol, & Chaiprapat, 2008; Mahapatra & Khan, 2007).

In this era of global competition, it is especially important for higher education institutions to continually seek opportunities to improve and sustain their service qualities. The universities in emerging countries show poor performance in terms of educational quality according to international rankings of higher education institutions, such as Times Higher Education and University Ranking by Academic Performance. This fact shows the need for increasing the quality of education, especially in emerging countries, to promote their economic wealth. Quality assurance systems such as "Bologna process" aim to make accreditation compatible with the European education system (Haug, 2003). In addition to these general accreditation systems, each country may need its own specific and qualitative quality assurance studies to increase their education quality.

The quality priority in higher education is in line with the concept of Total Quality Education, a culture characterized by increased customer satisfaction through continuous improvement, in which all employees and students actively participate (Mark, 2013; Raharjo, Xie, Goh, & Brombacher, 2007). Measuring student satisfaction could provide opportunities for course improvement (Douglas, Douglas, & Barnes, 2006). More emphasis should be placed on quality to recognize, meet, and even exceed the expectations of customers (DeShields Jr., Kara, & Kaynak, 2005). Highly satisfied students could recommend the institution to other stakeholders (Douglas et al., 2006) that could positively influence its reputation. Therefore, taking the Voice of the Customer (VOC) into consideration is essential for creating value for customers and achieving a higher level of satisfaction.

Despite its importance, accurate measurement of student satisfaction is a challenging task (Burgess, Senior, & Moores, 2018; Elliott & Shin, 2002). This is mainly due to various attributes of higher education services that affect student satisfaction. Accordingly, weighting the attributes based on their importance on the level of satisfaction could help ensure more accurate and simple measurement. Quality Function Deployment (QFD) methodology plays a critical role, in determining stakeholder needs and wants to provide solutions to improve the quality of education.

QFD implementations in higher education could be classified into five categories, as course quality (Hwarng & Teo, 2001), education quality (Koksal & Egitman, 1998), curriculum quality (Aytac & Deniz, 2005), teaching quality (Lam & Zhao, 1998), and research planning (Chen & Bullington, 1993). A relatively limited number of studies have focused on QFD implementation in course quality improvement (Kamvysi, Gotzamani, Andronikidis, & Georgiou, 2014).

Student satisfaction is measured from different dimensions ranging from quality of course to quality of library and food services. However, focusing on quality is relatively more important and quality of teaching is one of the most influential factors in overall student satisfaction (Burgess et al., 2018; DeShields Jr. et al., 2005).

In the field of higher education, the integration of QFD with other quantitative techniques may increase the reliability and the efficiency in gathering expectations of the customers (Gonzalez, Quesada, Gourdin, & Hartley, 2008). In the related literature, there are some approaches to improve the classical QFD. These current developments in QFD are called as the "third generation of QFD". The research about the third generation QFD methods is divided into two streams, namely, the *Japanese style* and *Western style* (Shiu, Jiang, & Tu, 2013). The integration of classical QFD with other techniques such as AHP or Kano model is referred as the Western Style third generation QFD. The difference between the third generation of Japanese and Western QFD is that while the Japanese QFD focuses on adding value to every work activity in new product development cycle by using real-time data, the Western QFD focuses on integrating various design tools to improve product quality (Shiu et al., 2013). That kind of integration could increase the translation of customers' expectations into the critical elements of an academic institution (Gonzalez et al., 2008). The Kano model can be a powerful technique to highlight the most important product features with significant influence on customer satisfaction. The rationale behind integrating the Kano model into QFD methodology is that the Kano model categorizes, differentiates and prioritizes the attributes of a product or service, focusing on how well they are able to satisfy customer needs (Shahin, Pourhamidi, Antony, & Hyun Park, 2013).

Some studies employ QFD together with Kano model in different service industries, such as tourism industry (Chang & Chen, 2011), financial services (Kashi, Astanbous, Javidnia, & Rajabi, 2012), and information systems (Chaudha, Jain, Singh, & Mishra, 2011). Yet, there is a lack of empirical research that integrates QFD with the Kano model in the field of higher education. Accordingly, the purpose of this study is to apply the QFD method together with the Kano model for a specific course in a state university in an emerging country to increase the quality of a higher education course.

The paper is organized as follows: Section 1 discusses the theoretical background of the QFD methodology, QFD in higher education and the Kano model. Section 2 discusses the methodology, including the sample, the data collection, and the empirical results. The discussion, managerial implications and directions for future research conclude the paper.

Theoretical Background

Quality Function Deployment

Quality has been defined in many ways in the relevant literature. According to Juran (1988), quality is defined in terms of the degree of the product's conformance to its requirements to sustain customer satisfaction and in terms of a product that contains no defects. The customer-based approach to quality focuses on satisfying the customer, while the manufacturing-based definitions evaluate quality as conformance to defined specifications (Garvin, 1984).

The concept of Quality Function Deployment (QFD) methodology was first developed in the late 1960s by Yoji Akau and Shigeru Mizuno and was born as a method for new product development under the umbrella of Total Quality Management (TQM) (Akao & Mazur, 2003). The QFD methodology has been implemented as a supportive methodology in various sectors, such as services, automotive, hospitality, and manufacturing (Muda & Roji, 2015).

QFD enables organizations to focus on the critical characteristics of a new or existing product or service from various perspectives of the customer, the company and the technological requirements (Chen, 2007). It is a useful methodology, as it includes the voice of the customer early in the design phase so that the final product can be better designed in accordance with the customers' needs. Moreover, it provides insights into manufacturing operation and has potential to improve the efficiency of production (Jaiswal, 2012).

Also known as house of quality, a generic QFD consists of consecutive stages to build (Han, Chen, Ebrahimpour, & Sodhi, 2001). Figure 1 provides an exemplar house of quality that could be drawn after the QFD methodology is employed. The methodology comprises the following main steps: *(i)* identifying student requirements where a market research is conducted via interviews or surveys, *(ii)* identifying technical requirements, *(iii)* identifying relationships among student requirements and technical requirements, and *(iv)* identifying interrelationships between technical requirements. The operations performed at each step are explained in the analysis section. The table below could help the reader to better position the Kano model into the QFD methodology. Here, the

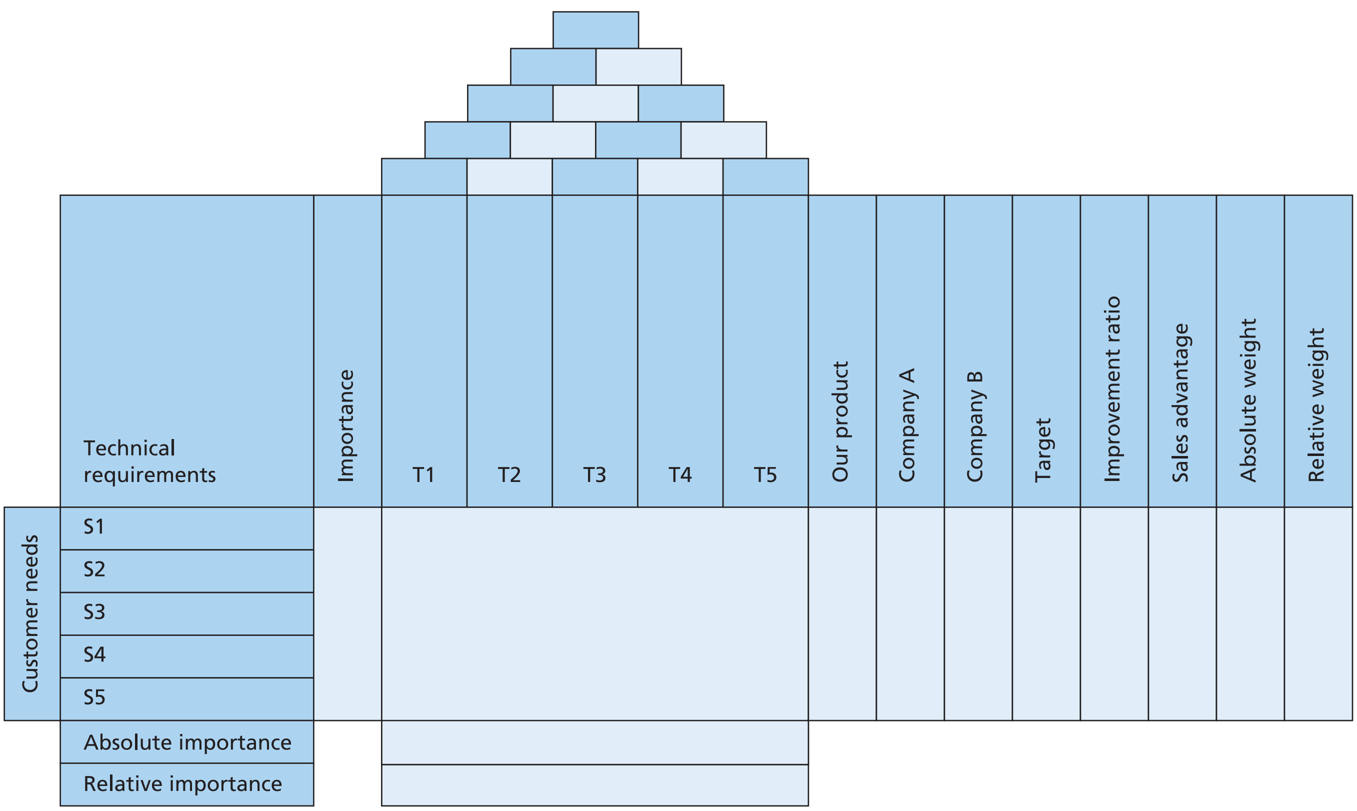


Figure 1. An exemplar house of quality.

Kano model contributes to the first step where the aim is to identify and categorize student requirements.

Quality Function Deployment in Higher Education

QFD, together with statistical process control and benchmarking, has been used as one of the most powerful TQM methodologies in the literature to assure customer satisfaction (Duffuaa, Al-Turki, & Hawsawi, 2003). In this study, we adopt the customer-based approach, since we focus on higher education student satisfaction.

Since the early 1990s, there have been a number of QFD applications in education (Gonzalez et al., 2008). Table 1 provides the studies that applied QFD in education in a chronological order. For instance, Mahapatra and Khan (2007) applied QFD to improve the quality in Technical Education System. In order to improve the quality at industrial engineering department, Raharjo et al. (2007) implemented QFD via AHP through gathering evaluations of students, lecturers, and employers. Hafeez and Mazour (2011) applied the QFD methodology to evaluate the quality of delivery of undergraduate courses from the perspective of students, the faculty, course outcomes and course assessments with a case study. Kamvysi et al.'s (2014) study concentrated on students' expectations and combined Fuzzy-AHP, linear, Data Envelopment Analysis and QFD. In another study (Walters & Seyedian, 2016), academic advising process of the Business Administration Department was designed using QFD by focusing on the expectations of faculty members and students.

A few studies concentrated on Operations Management course quality improvement. For instance, Hwarng and Teo's study (2001) compares an Operations Management course with Purchasing and Material Management and Warehouse and

Table 1. Some selected studies that applied QFD in higher education.

Year / Author	Method	Country	Field of Application
Pitman et al. (1995)	QFD	USA	To improve MBA program.
Lam & Zhao (1998)	QFD and AHP	Hong Kong	To improve teaching effectiveness in the Department of Applied Statistics and Operational Research.
Owlia & Aspinwall (1998)	QFD	Europe	To improve process and design in Engineering education.
Hwarng & Teo (2001)	QFD	Singapore	To increase teaching effectiveness and to design curricula in Business School.
Duffuaa et al. (2003)	QFD	Saudi Arabia	To design basic Statistics course.
Gonzalez et al. (2008)	QFD and benchmarking	USA	To design Supply Chain Management academic curriculum.
Mahapatra & Khan (2007)	QFD	India	To prioritize policies in technical education.
Raharjo et al. (2007)	QFD and AHP	Singapore	To improve the quality of higher education.
Chen (2007)	QFD	Taiwan	To plan curriculum in the Department of Business Administration.
Boonyanuwat et al. (2008)	QFD	Thailand	To design a curriculum for Industrial Engineering.
Jnanesh & Hebbar (2008)	QFD	India	To develop a curriculum for Engineering Education.
Verna (2014)	QFD	Italy	To design university course of Accounting.
Kamvysi et al. (2014)	QFD, Fuzzy AHP and DEA	Greece	To prioritize students' requirements for course design.
Muda & Roji (2015)	QFD	Malaysia	To obtain feedback from the employers to determine the most preferred criteria in selecting students for industrial training placement.
Al-Bashir (2016)	QFD, Affinity Diagrams, Tree Diagrams, Pareto Charts, and Fishbone Diagrams	United Arab Emirates	To assess and improve the quality of Faculty of Engineering.
Liang, Lee, & Liu (2016)	QFD and Design-oriented demand of Virtual Reality	Taiwan	To improve industrial design education and students' learning.
Walters & Seyedian (2016)	QFD	USA	To design the academic advising process of a Business Administration Department.
Wagner et al. (2017)	QFD, AHP and Servqual	Brazil	To evaluate the quality of a higher education institute from employee's viewpoint.
Singh & Rawani (2019)	QFD	India	To prioritize National Board of Accreditation quality parameters in engineering education.
Kamat & Kittur (2019)	QFD, AHP and Expero model	Sweden	To assess and evaluate effectiveness of engineering education.
Gonzalez, Quesada, Martinez, & Gonzalez-Cordoba, (2019)	QFD, benchmarking and the Hoshin Kanri Planning Process	USA	To identify the main factors that students consider when selecting abroad programs at US universities.

Storage Management by using QFD. Gonzalez et al. (2008) used QFD in Supply Chain Management course design.

The literature review shows that QFD was used for different purposes, such as to prioritize quality parameters in higher education and to identify the main factors that students consider when selecting study abroad programs. Another conclusion that can be drawn from Table 1 is that Analytical Hierarchy Process (AHP) was the most commonly used method together with QFD in prioritizing the customers' needs. Table 2 presents the studies applying QFD in Higher Education in Turkey. The chronological order of the studies conducted in Turkey as listed in Table 2 clearly shows that QFD has been commonly used in engineering and Business Administration education and there is a lack of research using QFD together with the Kano model.

The Kano Model

The Kano model, developed by Kano, Seraku, Takahashi, and Tsuhi (1984), is a technique used to identify the types of customer requirements and expectations in order to increase customer satisfaction (Lo, Shen, & Chen, 2016). The model was developed based on the motivation-hygiene theory of Herzberg, Mausner, and Snyderman (1959) that classifies customer satisfaction factors into two groups (*i.e.* hygiene and motivator factors). In the Kano model, these two groups causing customer satisfaction/dissatisfaction are increased to five preference categories. The generally accepted linear relationship between the fulfillment of customers' needs and their satisfaction is criticized in the model and it is called a 'one-dimensional quality' relationship (Shahin, Pourhamidi, Antony, & Hyun Park, 2013). Instead, the Kano model categorizes the attributes of a product, focusing on how well they are able to satisfy customers' needs emphasizing the non-linear nature of the fulfillment of customers' needs (Shahin et al., 2013). These categories are Must-be (M), One-dimensional (O), Attractive (A), Indifferent (I), and Reverse Quality (R) features/needs of customers. After the introduction of the original Kano model, a number of researchers have developed different combinations of these factors (*i.e.* Brandt & Scharioth, 1998; Cadotte & Turgeon, 1988; Yang, 2005).

Must-be (basic) needs are the most important factor of Kano model. They indicate the basic features that a product must have to meet the customer demands (Lo et al., 2017). The fulfillment of these needs does not necessarily result in customer satisfaction since customers perceive these as basic features of the product (Lo et al., 2017). Yet, their absence will be very dissatisfying and destructive. Therefore, service providers should analyze, organize and continuously improve these basic features. In the case of course design, the lecturer's scientific qualifications, for instance, can be considered as a must-be need for education.

Unlike must-be needs, *one-dimensional (performance)* needs result in customer satisfaction when they are fulfilled but cause dissatisfaction when they are not. In other words, these are the product features that already exist and cause neither satisfaction nor dissatisfaction until their performance is increased or decreased (Shahin et al., 2013). Because of their neutral position, performance factors represent an opportunity for product improvement (Matzler & Hinterhuber, 1998). The development of a feature and making it better, easier, or faster represent the nature of these needs (Shahin et al., 2013). An example can be an online platform for a handout that can result in student dissatisfaction, if not utilized weekly.

Attractive or exciting needs are also known as delighter factors (Hartono & Chuan, 2011) or surprising quality (Kano et al., 1984). Fulfilling these needs provide customer satisfaction, but do not cause dissatisfaction when they are not fulfilled. These are the product features that are not normally expected or even noticed by the customers. Therefore, these product features create satisfaction by surprisingly delighting customers beyond their expectations (Shahin et al., 2013). Customers are not usually aware of these needs. Therefore, service providers should

Table 2. Studies that applied QFD in higher education in Turkey.

Author	Methodology / Contribution / Research findings
Koksal & Egitman (1998)	QFD and AHP were used to improve industrial engineering education quality at the Middle East Technical University from the viewpoint of students, faculty members and future employers of the students.
Aytac & Deniz (2005)	QFD was applied to design the curriculum of the Tyre Technology Department at the Kocaeli University from employers' perspective.
Yalçın (2008)	QFD was used for the design of cost accounting and management accounting courses. Students were regarded as customers and AHP was used to determine their needs and wants.
Okur, Nasibov, Kilic, & Yavuz (2009)	Student needs and opinions were determined by using QFD with Ordered Weighted Averaging in the Department of Textile Engineering at Dokuz Eylul University.
Sagnak, Kazancoğlu, & Ada (2015)	QFD and AHP methods were incorporated to improve Business Administration education.

diagnose these needs and find solutions to satisfy them (Cheng Lim, Tang, & Jackson, 1999). Diagnosing an exciting need and developing a product feature to satisfy this need provides an innovative role for a service provider and soon can be imitated by competitors (Shahin et al., 2013). For instance, an unexpected guest speaker or an industry trip during a class may delight students and increase their course satisfaction.

Indifferent quality needs refer to the product features that customers will be indifferent whether the quality is present or not (Kuo, 2004). Fulfilling these needs does not result in customer satisfaction or dissatisfaction. Another way to manage these attributes may be to increase customer recognition to transform these needs into attractive ones.

Finally, *reverse quality needs* refer to a high degree of product achievement resulting in customer dissatisfaction. Some customers do not perceive this need as a required product feature and may prefer this feature to be removed from the product (Onyeaghala, 2016). For instance, regarding course satisfaction, some students may prefer high-level class discussion, while others may prefer the classical course design and may feel dissatisfied if a lecturer promotes too much class discussion.

The use of QFD Methodology together with the Kano Model

The evolutionary direction of the Western QFD focuses on integrating various design tools and methods to competitively improve product quality (Jiang, Shui, & Tu, 2008). Kano is one of these tools used in the third generation Western QFD. The Kano model is combined with the QFD methodology to overcome the challenges of traditional QFD to accurately specify customer expectations (Griffin & Hauser, 1993; Lo et al., 2017). Combining the Kano model with QFD supports a deeper understanding of customer requirements and problems (Matzler & Hinterhuber, 1998). The Kano model helps identify the main service features that have the greatest influence on customer satisfaction (Matzler & Hinterhuber, 1998). Moreover, it enables customized solutions according to the needs of different customer segments.

There are different approaches to integrate the Kano model into QFD in the relevant literature (Lo et al., 2017). For instance, Matzler and Hinterhuber (1998) developed a technique to specify the correlations between customer requirements obtained by the Kano model and technical requirements in QFD to identify design priorities in ski products. Based on Matzler and Hinterhuber's approach, Sireli, Kauffmann, and Ozan (2007) proposed a more detailed step-by-step method adjusting the Kano-QFD combination for simultaneous multiple product designs. Another technique to combine the Kano and QFD was developed by Tan and Shen (2000). They used an improvement ratio and equation to specify Kano categories that are used as customer requirements on QFD.

In previous research, the Kano model has been used together with QFD to integrate VOC into QFD matrices. Although there seems to be no study using the Kano model in conjunction with QFD in the education literature as seen in Table 1, the QFD methodology was used together with the Kano complementarily in several industries to improve customer-perceived quality, such as financial services (Kashi et al., 2012), information systems (Chaudha et al., 2011), tourism industry (Chang & Chen, 2011), project management (Lo et al., 2017), and medical industries (Chou, Tsai, Pai, Yen, & Lu, 2014). For instance, Lo et al. (2017) conducted a study to increase the project management (PM) process of a Taiwanese earphone manufacturing company and first specified relatively important processes for manufacturing using the Kano model and then utilized QFD to integrate the PM tools and techniques.

Method

This study focuses on the quality improvement of a Production and Operations Management (POM) course at a Business Administration bachelor degree program in a public university in Turkey. Production is one of the main functions of a business, and POM is a compulsory course in Business Administration Departments. However, it is a relatively less attractive course compared to the other Business Administration courses (Luque & Machuca, 2003). Accordingly, the POM course was selected for quality improvement. In order to conduct competitive analysis, two other production-related courses, namely, Supply Chain Management (SCM) and Service Operations Management (SOM) were also examined. In order to combine the QFD methodology with the Kano model, the following steps were taken:

- The VOC was identified via the Kano model. For this purpose, the student requirements were determined by conducting a focus group and a survey research. Afterwards, Kano categories of student requirements were identified. Then, the coefficients of customer satisfaction, customer dissatisfaction, and improvement ratios were calculated.
- The competitive analysis was conducted.
- The technical requirements were identified via in-depth interviews with the lecturers in the Production and Operations Management field.
- The relationships among student requirements and technical requirements were analyzed.
- The interrelationships among the technical requirements were identified.
- The house of quality was built and interpreted.

Identifying VOC via the Kano Model

The customers of a higher education institution may consist of lecturers, students, employers of graduates, graduates, administrative and service staff, parents, government, and local community (Kamvysi et al., 2014; Raharjo et al., 2007). From a pedagogical viewpoint, students are the primary customers of the education system (Mahapatra & Khan 2007; Raharjo et al., 2007). This is especially valid at the course level (Kamvysi et al., 2014). Moreover, the field of education has always been criticized by being process-oriented instead of being student-oriented (Pitman, Motwani, Kumar, & Cheng, 1995). Thus, this study considered students who are enrolled in a POM course and the related SCM and SOM courses as customers.

Sampling and Data Collection

In order to identify VOC, student requirements needed to be determined. At first, a pool of requirements was generated by reviewing the previous studies (Desai & Inman, 1994; Gibson, 2010; Gonzalez et al., 2008; Koksal & Egitman, 1998; Liu, Lee, Lin, & Tseng, 2013; Mahapatra & Khan 2007; Okur et al. 2009; Raharjo et al., 2007). Next, a focus group interview was conducted with 9 students (6 male and 3 female) enrolled in the three courses mentioned above. The aim of the focus group was to determine the course attributes for an ideal POM course in our specific context. The audio-recorded interviews lasted approximately 70 minutes. The students answered the questions related to the structure of the course, the course content, and the lecturer. The focus group revealed 22 attributes as student requirements from a POM course. The student requirements identified in the focus group are shown in Table 3.

After determining the student requirements, a survey was conducted to examine satisfaction levels and competitive performance. The data were gathered through the use of a self-administered Kano questionnaire. As suggested by Matzler and Hinterhuber (1998), for each requirement, a pair of questions was formulated representing the functional form and dysfunctional form of the question. The former measured the response of the student on whether the product met the mentioned requirement. The latter measured the response about whether the product did not meet the requirement. The students indicated their response to the questions with the following statements: “I like it that way”, “It must be that way”, “ I am neutral”, “I can live with it that way”, “I dislike it that way”. This part consisted of 22 pair of questions for the requirements identified in the focus group. Besides, the self-importance of student requirements were measured on a 5-point Likert type scale (1= Not very important; 5= Very important). The performance of the POM course and two other selected courses were also measured on a 5-point Likert type scale (1= Strongly agree, 5= Strongly disagree). We also asked gender and Grade Point Average (GPA) scores of the participants for demographic purposes.

The population of our survey consisted of 64 students enrolled in the *Production and Operations*, *Supply Chain Management*, *and Quality Management* courses. We employed total population sampling and collected 59 usable questionnaires, yielding a response rate of 92%. The sample population was 47.5% female and 52.5% male. The average GPA of the sample was 2.77 over 4.0, ranging from 1.92 to 3.9.

Analysis

To identify the Kano categories of student requirements (SRs), the answers to functional and dysfunctional questions were incorporated in the Kano evaluation table and interpreted

Table 3. Student requirements identified in the focus group.

No	Explanation
SR1	This course enriches my CV.
SR2	This course provides information on my manufacturing career goals.
SR3	Course activities (homework, case studies, etc.) are sufficient to transform theoretical knowledge into practice.
SR4	Technical trip within this course are satisfactory.
SR5	Course content doesn’t overlap with other courses.
SR6	This course clearly provides theoretical knowledge.
SR7	Quantitative methods (models) are sufficiently covered in this course.
SR8	Lecturer has sufficient theoretical knowledge.
SR9	Lecturer has sufficient update industrial knowledge.
SR10	Course sources are updated.
SR11	Lecturer is good at lecturing.
SR12	Lecturer has empathy (able to understand academic needs and willing to help) for students.
SR13	Examinations properly measure success.
SR14	Lecturer provides feedback on homework, exams, and projects.
SR15	Lecturer is qualified at foreign language skills.
SR16	Lecturer manages the classroom effectively.
SR17	Projects in this course are beneficial.
SR18	This course is an interactive course (in terms of student attraction and participation).
SR19	Lectures are supported with audio tools (e.g. PowerPoint, video).
SR20	Technical proficient speakers are invited to this course.
SR21	Course materials are shared via online channels.
SR22	This course is improved based on student feedback.

according to the frequency of answers, as offered by Matzler and Hinterhuber (1998) (Table 4).

As it can be seen in Table 4, most of the SRs (*n*=10) were categorized as one-dimensional need. Relatively fewer number of SRs (*n*=7) were categorized as indifferent. The rest (*n*=5) fell in the Kano category of attractive needs. The participants regarded none of the student requirements as must-be needs.

To better classify the SRs in each category, customer satisfaction coefficient (CS) and customer dissatisfaction coefficient (CD) were examined as offered by Berger et al. (1993). The CS and CD have been regarded as supplementary tools in the QFD process (Tontini, 2007). The coefficients in Figure 2 show the influence of product features on satisfaction or dissatisfaction with a bar diagram.

Based on the coefficient of satisfaction shown in Figure 2, student requirements of SR21, SR22, and SR12 made the highest contribution to the satisfaction level (CS = .83, .78, .73, respectively). However, they led to a moderate level of dissatisfaction if the requirements have not been fulfilled (CD = .55, .57, .59, respectively). The one-dimensional requirements that caused students to be relatively highly dissatisfied were SR8, SR13, and SR11 (CD = .68, .64, .61, respectively). Other one-dimensional requirements that could slightly increase satisfaction (dissatisfaction) were SR9, SR6, SR15, SR16, and SR14 (CS (CD) = .66 (.56), .59 (.48), .57 (.48), .57 (.38), .53 (.27), respectively). Among the attractive requirements, the fulfillment of

Table 4. The quality categories of SRs.

	Kano category		
	One-dimensional	Attractive	Indifferent
Student requirement	SR6	SR1	SR3
	SR8	SR2	SR5
	SR9	SR4	SR7
	SR11	SR10	SR14
	SR12	SR20	SR17
	SR13		SR18
	SR15		SR19
	SR16		
	SR21		
	SR22		
Total (*n*)	10	5	7

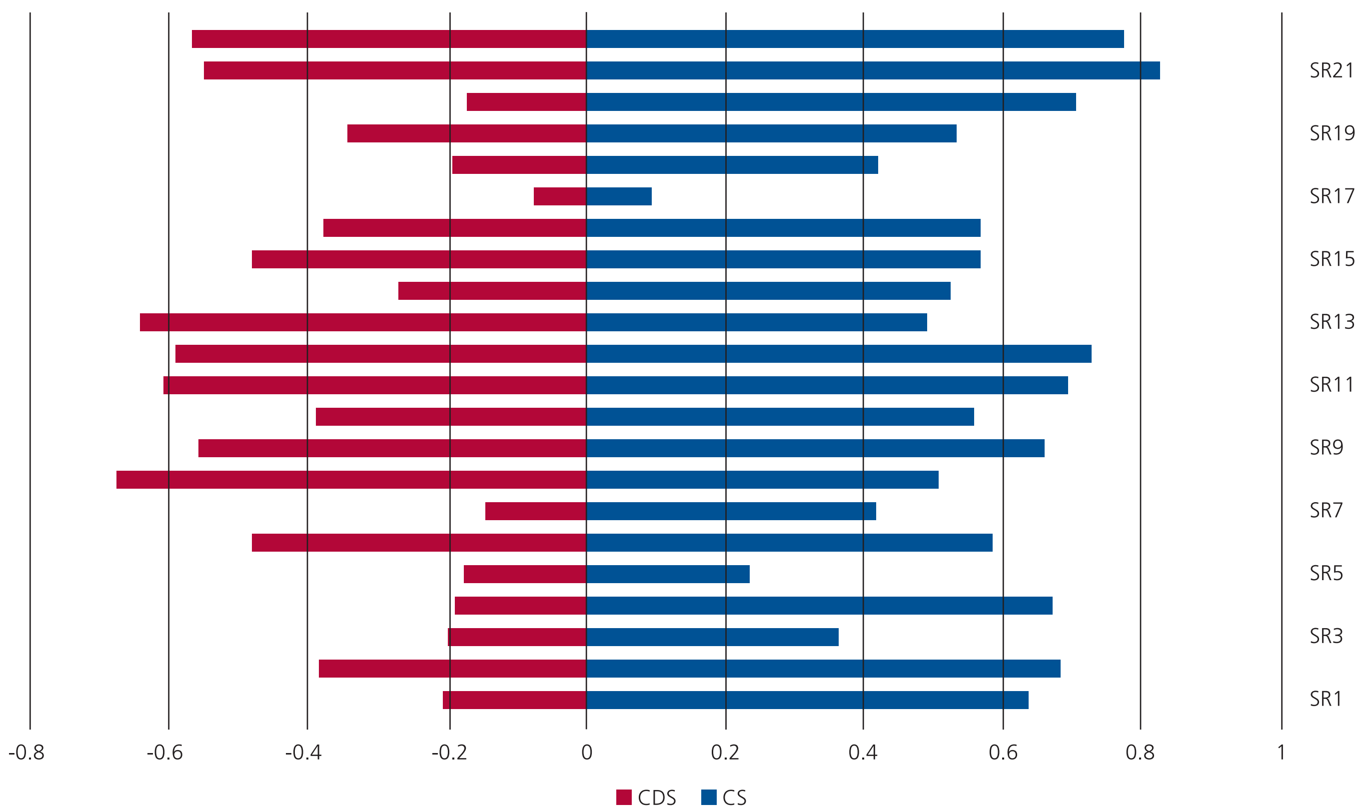


Figure 2. The coefficients of customer satisfaction (CS) and customer dissatisfaction (CDS).

SR20 resulted in the highest level of satisfaction (CS = .71). SR2, SR4, SR1, and SR10 resulted in a moderate or slight increase in satisfaction (CS = .68, .67, .64, .56, respectively). Consequently, SR8, SR11, SR12, SR13, SR20, SR21, and SR22 were important factors for the improvement of course quality. Among these, SR 20 was an attractive requirement and the rest of the requirements were found as one-dimensional requirements. They were related with the evaluation of the lecturer and the structure of the course.

For competitive analysis, students' satisfaction rates were calculated for all three courses for each requirement. The adjusted improvement ratio IR_{adj} was also assessed. In competitive analysis, this study sets the highest level of satisfaction as the target similar to previous studies. Then the improvement ratio (*IR*) was estimated with the following formula (Hsu, Chang, Wang, & Lin, 2007):

IR = Target / The current customer satisfaction value of POM

Afterwards, IR_{adj} was calculated through using values of the Kano categories with the following formula (Hsu et al., 2007; Tontini, 2007):

$$IR_{adj} = (IR_0)^{1/k}$$

The research team can determine the values of k subjectively. This study adopted the values in previous studies as (*k*=0.5; 1; 2 for M, O, and A, respectively) (Tontini, 2007).

As the last step of the competitive analysis, adjusted importance $Impr_{adj}$ was assessed by multiplying the adjusted improvement ratio by the raw importance for each customer attribute as presented in the following equation:

$$Impr_{adj} = \textit{the raw importance} \times IR_{adj}$$

Table 5 presents the results of competitive analysis including satisfaction rates, adjusted improvement ratios, and adjusted importance rates.

As shown in Table 5, the SCM and the SOM courses performed better than the POM course on most of the requirements. Especially, the SCM and the SOM outperformed the POM on SR8, SR11, SR7, SR16, SR15, SR12, SR9, and SR22. Accordingly, those requirements had relatively higher adjusted improvement and importance ratios. As for SR20 and SR4, all courses had low performance. SR4 was the requirement that had the highest adjusted improvement ratio. Further, sales advantage refers to whether an improvement on student requirement will contribute to the course demand (Warwick Manufacturing Group, 2007). Based on the interviews with the experts in POM field, the sales advantage of each student requirement was determined. The following numbers were used to present the level of impact (1.5= Increases course demand significantly; 1.2= Increases course demand; 1= Does not make any significant change) (Çalıpınar & Soysal, 2010; Güllü & Ulçay, 2002; Han et. al., 2001).

Using the determined impact levels, improvement ratios and importance levels, absolute and relative weight for each student requirement was calculated by means of the following formulas (Foster, 2007):

Absolute weight$_s$ = importance level$_s$ × improvement ratio$_s$ × sales advantage$_s$, for all $s \in S$.

$$\text{Relative weight}_s\,(\%) = \left(\frac{\text{Absolute weight}_s}{\text{Total absolute weight}}\right) \times 100, \text{ for all } s \in SR.$$

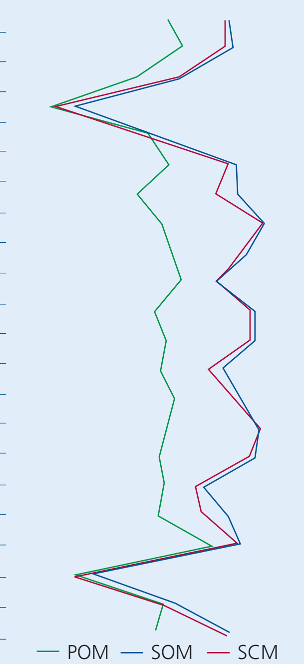
where set SR refers student requirements in the above formulas.

Identifying Technical Requirements

In order to achieve quality improvement of the POM course, the next step was to identify the supporting technical requirements. After having interviews with the faculty (3 experts in the operations management field), and considering the literature (Duffuaa et al., 2003; Hwarng & Teo; 2001; Kamvysi et al., 2014; Owlia & Aspinwall, 1998), the technical requirements

Table 5. The results of the competitive analysis.

Student requirement	IR_{adj}	$Impr_{adj}$	Satisfaction rates 1	2	3	4	5
SR1	1.13	4.26					
SR1	1.10	4.49					
SR3	1.13	3.91					
SR4	2.06	5.86					
SR5	1.07	3.46					
SR6	1.29	5.56					
SR7	1.51	6.07					
SR8	1.47	7.04					
SR9	1.32	6.17					
SR10	1.07	4.56					
SR11	1.48	6.94					
SR12	1.39	6.72					
SR13	1.28	5.17					
SR14	1.28	5.71					
SR15	1.43	6.83					
SR16	1.45	6.94					
SR17	1.17	4.68					
SR18	1.32	6.03					
SR19	1.11	5.48					
SR20	1.28	4.88					
SR21	1.06	5.10					
SR22	1.34	6.72					



required to satisfy the identified student requirements were determined. Each of these three audio-recorded interviews lasted approximately 30 minutes. These interviews revealed 25 technical requirements, as shown in Table 6.

Identifying Relationships Among Student Requirements and Technical Requirements

After conducting the necessary research, it was specified that there existed 22 student requirements and 25 corresponding technical requirements to satisfy them. After the SR and technical requirements (TR) were identified, the next step was to relate student requirements to the supporting technical requirements. Having interviews with the lecturers working in the operations management field enabled us to identify relationships between each student requirement and technical requirement. In total, three audio-recorded interviews were conducted with the same lecturers, each of which lasted around 45 minutes.

There existed varying degrees of the strength of the relationships between the SRs and TRs. The relationships categorized as strong, medium and weak carry a numeric value of 9, 3, or 1, respectively. An empty cell refers the fact that there is no relationship between the corresponding SR and TR. Using these assigned numeric values, the absolute and relative importance of each technical requirement was calculated by means of the following formulas (Foster, 2007) where set SR refers to student requirements and set TR refers to technical requirements.

$$\text{Absolute importance}_t = \sum_{i \in SR} \text{absolute weight}_i \times \text{power of relationship}_i, \text{ for all } t \in TR.$$

$$\text{Relative importance}_t\,(\%) = \left(\frac{\text{Absolute importance}_t}{\text{Total absolute importance}} \right) \times 100, \text{ for all } t \in TR.$$

After calculating the aforementioned importance rates, more importance was given to those technical requirements that had higher absolute and relative importance scores.

Table 6. Technical requirements.

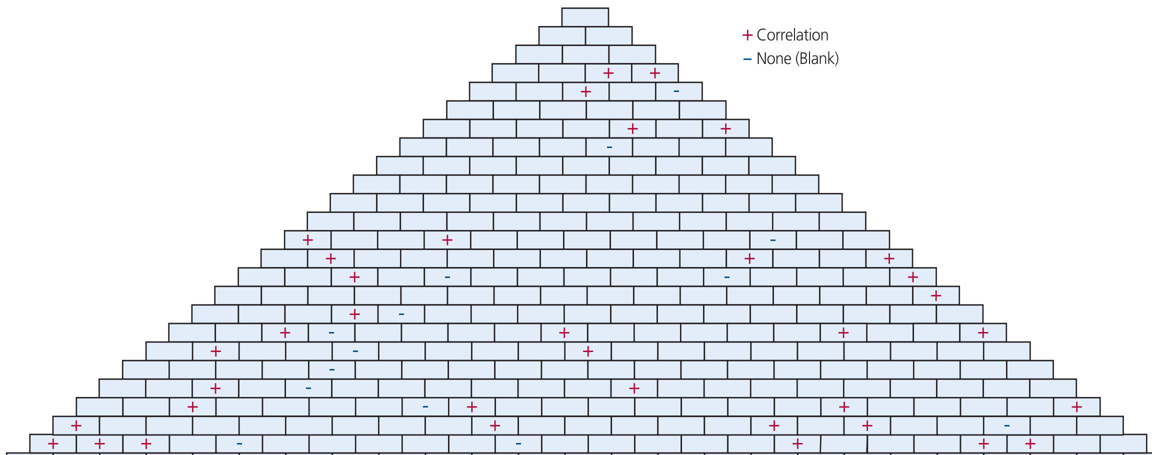
No	Technical requirement
TR1	Multi-media in class (projector, smartboard, speaker, computer, etc.)
TR2	Access to internet in class
TR3	Budget/Funds (for invited speaker, factory visits, etc.)
TR4	Invited speakers
TR5	Number of students enrolled
TR6	Free access to software for lecturers and students
TR7	Aesthetics / ergonomic class
TR8	Online platform for handouts
TR9	Teamwork (Group project)
TR10	Industry trip
TR11	Lecturer workload
TR12	Updated course material (case, software, textbook, etc.)
TR13	Well-equipped lab
TR14	The coordination among courses
TR15	Good communication empathy
TR16	Local cases
TR17	Lecturer qualifications
TR18	Competency in teaching
TR19	Explanation of course structure
TR20	Problem-solving
TR21	Office hour
TR22	Close supervision of students' work
TR23	Number of research assistants
TR24	Library resources (textbook, articles, additional resources, CD, video, etc.)
TR25	Promoting class discussion

Identifying Interrelationships Between Technical Requirements

The next step in building house of quality was to identify interrelationships between the technical requirements (Warwick Manufacturing Group, 2007). This is the triangular matrix located at the top of the house of quality. Similar to the previous two steps, these interrelationships were identified by interviewing the same three lecturers. Symbols were used to indicate the strength of the relationship (+ indicating a positive relationship and – indicating an inverse relationship) (Singh, Grover, & Kumar, 2008).

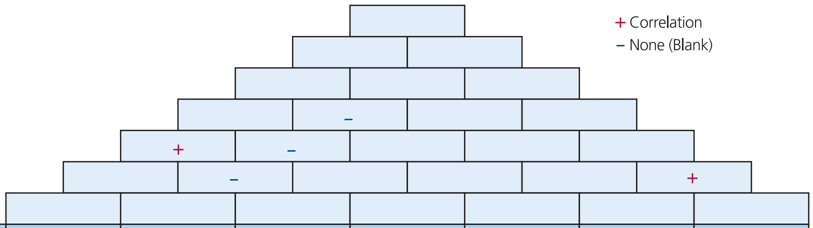
In Figure 3 (roof part) an empty cell without the symbol refers to the fact that there is no relationship between the corresponding technical requirements. After all, these steps were implemented and the house of quality for the POM course was built.

Figure 4 presents a focused QFD house that illustrates the relationships between the TRs and SRs that were perceived as prominent among the others. The SRs with a relative weight higher than 5 and the TRs that had relative importance higher than 5 were regarded as prominent. For instance, to achieve an improvement on SR11 "Lecturer is good at lecturing", which was the most prominent student requirement perceived, technical requirements of TR5 (number of students enrolled), TR11 (lecturer workload), TR15 (good communication), TR17 (lecturer qualifications) and TR18 (competency in teaching) had to be improved. Moreover, the roof of the focused quality house represented the interrelationships between the prominent technical requirements. For instance, the increase of "number of students enrolled" will have a negative impact on the technical requirements of TR10 (industry trip), TR11 (workload of lecturer), and TR15 (good communication).



																											Current situation							
Student needs / Technical requirements	Importance	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11	TR12	TR13	TR14	TR15	TR16	TR17	TR18	TR19	TR20	TR21	TR22	TR23	TR24	TR25	SOM course	SCM course	POM course	Target	Improvement ratio	Sales advantage	Absolute weight	Relative weight
SR1	3.9	0	0	1	1	0	3	0	0	3	9	0	3	3	0	0	1	9	0	0	0	0	0	0	1	0	3.9	3.9	3.1	5	4.3	1.5	24.8	3.7
SR2	4.2	0	0	1	9	0	1	0	0	1	9	0	3	3	0	0	1	9	3	0	3	0	1	0	1	0	4.0	3.9	3.3	5	4.5	1.5	28.0	4.2
SR3	3.5	3	3	3	9	1	9	0	0	3	9	3	3	9	0	0	9	9	9	0	9	0	3	3	0	9	3.3	3.3	2.7	5	3.9	1.2	16.3	2.4
SR4	2.8	0	0	9	0	9	0	0	0	0	9	9	0	0	0	0	0	3	3	0	0	0	0	1	0	0	1.8	1.5	1.5	5	5.9	1.5	24.7	3.7
SR5	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	1	0	9	0	0	0	0	0	0	3.0	3.0	2.8	5	3.5	1.2	13.2	2.0
SR6	4.3	9	9	1	1	1	3	3	1	0	0	9	9	9	9	9	1	9	9	3	9	3	3	3	3	3	4.0	3.9	3.1	5	5.6	1.5	35.4	5.3
SR7	3.9	3	0	0	0	1	9	0	1	0	0	9	3	9	1	0	0	9	9	1	9	3	3	3	1	0	4.0	3.8	2.7	5	6.1	1.2	28.7	4.3
SR8	4.7	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	1	1	0	0	0	0	0	3	0	4.4	4.4	3.0	5	7.0	1.5	49.5	7.4
SR9	4.5	0	0	9	9	0	3	0	0	0	9	9	9	3	0	0	3	3	0	0	0	0	0	1	1	0	4.2	4.1	3.2	5	6.2	1.5	41.9	6.2
SR10	4.1	9	9	9	3	0	9	0	3	0	1	9	9	3	0	0	1	3	3	3	1	0	0	1	3	0	3.7	3.8	3.3	5	4.6	1.5	28.0	4.2
SR11	4.5	1	1	0	0	9	1	3	1	0	0	9	0	3	0	9	0	9	9	1	3	0	0	0	0	9	4.3	4.2	2.9	5	6.9	1.5	46.8	7.0
SR12	4.6	0	0	0	0	9	0	0	0	0	0	3	0	0	0	9	0	9	1	1	0	3	3	0	0	0	4.3	4.2	3.1	5	6.7	1.2	37.3	5.6
SR13	3.8	0	0	0	0	9	0	0	0	0	0	1	3	3	0	0	0	9	0	0	0	0	0	9	0	0	3.9	3.6	3.0	5	5.2	1.2	23.3	3.5
SR14	4.2	0	0	0	0	9	0	0	3	0	0	9	0	0	0	3	0	3	0	1	0	9	3	3	0	0	4.1	4.0	3.2	5	5.7	1.2	28.5	4.2
SR15	4.5	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	4.3	4.4	3.1	5	6.8	1.2	36.6	5.5
SR16	4.4	1	1	0	0	9	0	9	0	0	0	0	0	0	0	9	0	1	9	0	0	0	0	0	0	0	4.3	4.2	3.0	5	6.9	1.5	46.2	6.9
SR17	3.6	3	3	0	0	9	3	1	1	9	1	3	1	1	0	0	0	3	1	0	1	1	3	9	0	0	3.6	3.5	3.1	5	4.7	1.2	20.2	3.0
SR18	4.2	9	9	9	9	9	9	9	3	9	9	9	3	3	0	9	3	3	9	9	1	9	9	9	0	9	3.9	3.6	3.0	5	6.0	1.2	30.1	4.5
SR19	4.5	9	9	9	9	1	3	3	3	0	9	9	3	9	0	0	0	1	1	0	0	0	0	1	3	0	4.1	4.1	3.7	5	5.5	1.2	29.6	4.4
SR20	3.3	0	0	9	9	9	0	3	0	0	9	9	0	0	0	1	0	3	0	0	0	0	0	1	0	0	2.1	1.8	1.8	5	4.9	1.5	24.2	3.6
SR21	4.3	1	1	0	0	1	0	0	9	0	0	1	3	0	0	1	0	1	3	1	0	0	0	1	0	0	3.2	3.0	3.1	5	5.1	1	22.0	3.3
SR22	4.5	0	0	0	0	3	0	0	0	0	0	3	0	0	0	3	0	3	3	0	0	0	0	1	0	0	4.0	3.8	2.9	5	6.7	1.2	36.0	5.4
Absolute importance		1418.5	1332.4	1854.1	1675.3	2771.8	1457.9	1115.0	677.5	603.4	2024.6	3286.3	1725.0	1678.7	516.3	2002.5	478.7	3136.5	2421.1	743.4	1026.4	851.4	797.7	1194.9	551.0	945.1								
Relative inportance		3.9	3.7	**5.1**	4.6	**7.6**	4.0	3.1	1.9	1.7	**5.6**	**9.1**	4.8	4.6	1.4	**5.5**	1.3	**8.6**	**6.7**	2.0	2.8	2.3	2.2	3.3	1.5	2.6								

Figure 3. The house of quality.



Studen needs	Technical requirements	Importance	T3	T5	T10	T11	T15	T17	T18	Relative weight
	SR6	4.3	1	1	0	9	9	9	9	5.3
	SR8	4.7	0	0	0	1	0	1	1	7.4
	SR9	4.5	9	0	9	9	0	3	0	6.2
	SR11	4.5	0	9	0	9	9	9	9	7.0
	SR12	4.6	0	9	0	3	9	9	1	5.6
	SR15	4.5	3	0	0	0	0	3	1	5.5
	SR16	4.4	0	9	0	0	9	1	9	6.9
	SR22	4.5	0	3	0	3	3	3	3	5.4
		Total	1	3	1	3	4	3	3	

Figure 4. Focused quality house.

Discussion and Conclusion

The purpose of this study was to apply the Third Generation Western QFD methodology together with the Kano technique to improve the quality of a specific course in a state university in an emerging country. Thus, the VOC was identified through the Kano technique which enables categorization and prioritization of student requirements. Although QFD has been applied to higher education in previous studies (Lam & Zhao, 1998; Raharjo et al., 2007), incorporating the QFD with other analytical tools has been reported as an essential requirement for educational quality improvement (Kamvysi et al., 2014). The use of a variety of methods and techniques together, rather than relying on a certain technique was also consistent with other studies conducted in the services sector (*see* Chen, 2016; Deng & Kuo, 2008; Herbert, Curry, & Angel, 2003). Accordingly, this study tried to fulfill this gap in the literature by using the QFD methodology in combination with the Kano technique in promoting the quality of an undergraduate course.

In order to define the VOC part of the quality house, 22 student requirements were identified based on the focus group study. Afterwards, the data gathered from 59 students enrolled in *Production and Operations*, *Supply Chain Management*, and *Quality Management* courses were analyzed through the Kano evaluation table, as offered by Matzler and Hinterhuber (1998). Accordingly, the student requirements were grouped into three Kano categories as one-dimensional needs (10 requirements), indifferent needs (7 requirements), and attractive needs (5 requirements). It was seen that the students did not evaluate any characteristic related with the POM course as a *must-be* need.

One-dimensional needs were found to be the ones that were mostly lecturer-oriented attributes, such as the lecturer's theoretical and industrial knowledge, and lecturing skills. When focused QFD was screened, these student requirements were found to be the ones with the highest relative weights. Accordingly, the lecturer-oriented requirements including the lecturer's theoretical and industrial knowledge (relative weight = 7.4; 6.2, respectively), lecturing skills (relative weight = 7), and effective classroom management (relative weight = 6.9) were primarily considered in course quality evaluation. Moreover, lecturer's empathy (relative weight = 5.6), and foreign language proficiency (relative weight = 5.5) were important requirements in the course quality evaluations of students. Hence, since the one-dimensional needs cause neither satisfaction nor dissatisfaction until their performance is increased or decreased (Shahin et al., 2013), the increase in the quality of the POM course was directly related with the improvement of the lecturer qualifications.

The other Kano category, *indifferent needs*, unexpectedly, were found to generally cover the coursework (*i.e.* projects, exams, etc.) and technology adaption in the course design and implementation. This result questions the effect of the developing technology on the courses. Further, the *attractive needs* were found to be related with the interaction of the course with the industry such as "technical trips", "invited speakers", and "supporting career goals". This result is consistent with the findings of Mahapatra and Khan (2007) who underline the importance of Industry-Institute interface. Creating delight with the needs that are perceived to be attractive is likely to increase the satisfaction level of the students. For instance, "providing information on the students' manufacturing career goals" is perceived as an attractive need and has a high relative weight. Promoting this student requirement has potential for delighting students. The results indicate that *indifferent needs* and *attractive needs* are not considered prominent among the others (as relative weight values <5).

According to the results of the focused quality house, the prominent technical requirements were lecturer workload (relative importance = 9.1), lecturer qualifications (relative importance = 8.6), the number of students enrolled (relative importance = 7.6), competency in teaching (relative importance = 6.7), industry trip (relative importance = 5.6), good communication/empathy (relative importance = 5.5) and budget/funds for invited speaker, factory visits, etc. (relative importance = 5.1). These results are consistent with the previous studies indicating complaint of staff on workload (Hwarng & Teo, 2001), and high-quality faculty (Ozoglu, Gur, & Gumus, 2016) as important issues in establishing successful academic institutions.

These results can be attributed to the nature of the Turkish higher education system, since there is a high workload of lecturer on average, and the Council of Higher Education in Turkey sets the number of students enrolled in each undergraduate program. Accordingly, improvements in those numbers are based on public educational policies. Yet, our results show that the number of students was one of the most important technical requirements for improving the course quality since it had positive correlation with three other technical requirements. Therefore, decreasing the number of the students enrolled may also provide improvements in industry trip opportunities, the workload of the lecturer, and communication with the students.

The other technical requirements related with the lecturer also have to be improved. Consequently, the strategies that will promote the lecturer's quality should be the main element in the development and improvement of the POM course and other courses as well. Some of those strategies can be attending life-long learning courses, utilizing opportunities to generate international network, and encouraging academic research.

This study proposed two quality houses: One quality house includes the entire student and the technical requirements, while the second one which we named as 'focused quality house' includes only the most prominent requirements. Incorporating the QFD methodology with the Kano technique provided the opportunity to generate the focused quality house. Using the Kano technique together with the QFD methodology made it easier to identify the most important student requirements in creating satisfaction. This was achieved by categorizing requirements with a focus on how well they were able to satisfy customer needs. The requirements that did not create or increase student satisfaction were not included in the focused quality house. By eliminating these requirements from the classical quality house, the focused quality house, in turn, leads to the more detailed and focused explanation of the house of quality. For instance, the overlapping of the POM course with other courses and not being able to transform of theoretical knowledge into the practical knowledge did not contribute to student satisfaction. Moreover, with the better visual expression of focused quality house, the QFD methodology was easier to explain.

One of the limits of this study was considering solely students as customers. Although it is stated in the literature that students are the primary customers especially at the course level (Kamvysi et al., 2014; Mahapatra & Khan 2007; Raharjo et al., 2007), the customers of higher education consist of lecturers, graduates, employers of graduates, administrative and service staff, parents, government, and local community as well (Kamvysi et al., 2014; Raharjo et al., 2007). Therefore, other customer groups may be examined in future studies. Another limitation was that the methodology was only applied in a course in a public university. However, the techniques used in this study can be applied in other courses and programs. Future studies can concentrate on the combined use of the QFD methodology with the Kano technique in the design and the quality enhancement of other undergraduate, graduate, and postgraduate courses and in other sub-fields of the services sector. Customers other than students, such as parents of students, employers, or potential students of higher education organizations should be considered. Moreover, the QFD methodology may also be used together with other TQM techniques, which have not been done before.

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