



Research Paper

## An Evaluation of the Library Service Quality Using Six-Sigma Methodology

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### Article Info.

**Received:** 2019/10/05  
**Accepted:** 2020/02/15

### Keywords:

*Service Quality, Service Evaluation, Six-Sigma Methodology, Central Library of Astan Quds Razavi (CLAQR)*

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### How to Cite:

Ziaei, S., Biranvand, A. (2020). An Evaluation of the Library Service Quality Using Six-Sigma Methodology. *Journal of Studies in Library and Information Science*, 11(4), 43-54.

### Abstract

**Background and Objectives:** This study was intended to investigate the opinion of the users of the Central Library of Astan Quds Razavi (CLAQR) regarding the provided services using Six-Sigma methodology.

**Methodology:** This is an applied descriptive-survey study that explores the gap between the minimum level of expectations, the current status, and the maximum level of users' expectations regarding the human force services, information resources, and space available in the CLAQR. The data were collected by the Libqual Questionnaire and analyzed using SPSS 23.

**Findings:** The average score of 72.88% for users' opinions regarding the indicator of human force (HF) in CLAQR shows the relative satisfaction of users in this regard. Only the indicator of "prepared staff for answering the users' questions", with a 50% satisfaction score, failed to meet the minimum expectations of the users. The average score of 76.88% regarding users' opinions about the quality of the available resources in the library also indicates their relative satisfaction. Among the indicators related to the quality of resources, "audiovisual materials" received the highest satisfaction score (93.33%). The average score of 72.95% for users' opinions indicates overall satisfaction with space and amenities available. However, the scores of some sub-indicators such as "comfortable and pleasant place" and "the presence of proper space for studying and learning" related to the current status were even lower than the minimum expectation level

**Discussion:** The results show that overall, CLAQR has been successful in gaining 79.2% user satisfaction. The proximity of the actual level of service to the maximum level of users' expectations enhances the quality of service provided by the library, and it will be possible to gain users' maximum satisfaction with greater effort and focus on removing existing shortcomings.

## **Introduction**

Evaluation of service quality is directly related to and impacts the planning and promotion of service quality of organizations. It provides an opportunity for strategic planning and improving the quality of service in different parts of an organization. Six-Sigma is one of the tools and strategies organizations use to achieve accuracy and speed, and at the same time reduce costs and increase productivity and customer satisfaction. It is strategically positioned to change organizational culture by imposing order and controlling processes in manufacturing and non-manufacturing occupations. It is no longer a question of whether to use six-sigma; rather, the question is when and how to use it, because an organization cannot do today's work by yesterday's methods (Thawani, 2004).

Novel information technologies, and the increased level of expectations of users of libraries and information centers, make these centers to be in need of new management strategies and techniques so that they can comply with these changing needs and demands. Evaluation of the service quality in a library means evaluating the efficiency of service delivery. The service quality evaluation is not limited to the fact that the service is provided only to the user; it also focuses on the extent to which the users are using the service, how the service complies with their information needs, and their satisfaction with the quality and quantity of the service (Biranvand & Khasseh, 2013; Eckes, 2004). It is believed that service quality evaluation is the most difficult stage of evaluation because it is very difficult to measure how users' questions are answered, and how these answers really help users.

Although tangible items can be objectively evaluated, service delivery cannot be easily defined, identified and measured by its characteristic features. Therefore, the service quality is more of a subjective than an objective quality. We can observe results of an action in the form of emergence of its results and what was expected. However, the feedback from the results may not be visible first at the same time, and depending on the person's future vision or mentality about that action, it may yield different results, which cannot be observed and measured by objective criteria and be recognized as perceived quality of service by the user (Snee, 2010).

Six-Sigma is one of the novel tools for evaluating service centers, providing a deeper understanding of the provided services. While Libqual's Evaluation of Library Service Quality Questionnaire is the most commonly used tool for measuring library service quality and analyzing the gap between users' expectations and the current status of services received (Ramezani, Ghazimirsaeed, Azadeh, Bandboni, & YektaKooshali, 2018), Six-Sigma is a novel method of evaluation that explores the gap between library users' expectations and their satisfaction after receiving the services. This evaluation examines the differences between these two processes (expectations before using the service and satisfaction after receiving it). In comparison to the common methods that only examine users' satisfaction after receiving a service, Six-Sigma attempts to discuss the expectations of users from a service center such as the library so as to better understand the library community and users' expectations regarding the quality and quantity of library service (Kim, 2010; Kumi & Morrow, 2006).

Six-Sigma is in fact a "new quality management proposition" to improve services in the third millennium organizations. Six-Sigma means reducing defect rate to three or four defects per million opportunities, as a change in service quality management. The three main goals of using Six-Sigma are to increase customer satisfaction, reduce operation time, and reduce the number of faults (Biranvand & Khasseh, 2013). Six-Sigma states what we do not know and what we need to know in the service management process, how understanding defects in the system can contribute to the improvement of the operations and satisfaction of users and thus its success, and what should be done to reduce these defects and task duplications (Oliver, Oliver, & Chen, 2019; Sommer & Blumenthal, 2019).

Six-Sigma represents a commitment to management practices through process, not function, and making decisions based on facts and data rather than the inherent skills managers believe make them great executives (Eckes, 2004; Richard Jay Sands, 2015). Understanding a problem using this philosophy requires exploring

why the problem exists, where it originates from, and how a problem could be fixed in a way to prevent its recurrence (Lunau et al., 2013). The focus of Six-Sigma is on the customer rather than the product (Richard J Sands, 2015).

The quest to achieve Six Sigma originated at Motorola in 1979, when executive Art Sundry proclaimed that the real problem at Motorola was that its quality was not conforming with the standards required to compete in the market place (Harry & Schroeder, 2000; Pepper & Spedding, 2010; Richard J Sands, 2015). Sundry sparked a new era within Motorola and led to the discovery of the crucial correlation between higher quality and lower development costs in manufacturing products of all kinds. Between 1986 and 2001, based on implementation of the Six Sigma methodology, Motorola reported \$16 billion in cost savings, positioning Motorola as one of the pioneers and greatest beneficiaries of Six Sigma methodology ("The History of Six Sigma," n.d.). Despite the success of Six Sigma at Motorola, this philosophy became well known only after Jack Welch, the then-chairman and chief executive officer of General Electric, made it a central focus of his business strategy in 1995 (Davis, 2017; Richard J Sands, 2015). The Six-Sigma approach brings out the innovative aspects of an organization because this approach strives to elicit better performance if provided within the necessary environment (Mcmanus, 2008). Creativity and innovation are demonstrated when the working environment is conducive for and favorable to employees.

A review of the background of qualitative research carried out on libraries and information centers shows that in most cases, the LibQUAL questionnaire has been used in such quality assessments. Nonetheless, the use of Six-Sigma methodology to analyze the information service process is what makes the present study somewhat unique. This approach, which is used in this study, is considered to be a new step in evaluating the services of libraries.

In this context, Al-Zubi and Basha (2010) explored the role of Six-Sigma in improving service delivery and enhancing library user satisfaction. In this study, scientific and systematic strategies for providing services to users and meeting their demands and needs are introduced in the best possible way through the implementation of Six-Sigma. Moreover, activities with no added value have been eliminated to increase service delivery speed (Al-Zubi & Basha, 2010). Kim (2010) also stated that Six-Sigma follows top-down management and that the role of managers is of high importance in this regard. Success in library activities depends on how well each agent acts in each service delivery process (Kim, 2010). It is important to pay attention to improvement activities, evaluation of critical quality factors, and measurement of the results of improvements and enhancements based on appropriate indicators.

For an organization, greater defects means higher cost and lower quality of service, which in turn leads to reduced customer satisfaction. For businesses and commercial organizations, this means loss of competitive market. However, the case is different for libraries: users' dissatisfaction means that they will stop visiting the library and forget about the library. It can be concluded, then, that evaluation of service quality through Six-Sigma in any organization and improvement of service delivery practices are not an option but an inevitable necessity.

### **Research Background**

Many studies have been carried out on the evaluation of library services using the LibQUAL methodology. Notable works include (Al-Zubi & Basha, 2010; Asemi, Kazempour, & Ashrafi Rizi, 2010; Azimi Vaziri, Famil Rouhany, & Moradi, 2015; Biranvand & Khasseh, 2013; Esmaeilpour Bandboni, Abbaspour, Ramezani, Gholipour, & Ramezani Pakpour Langeroudi, 2015; Mardani & Sharifmoghadam, 2012; McCaffrey & Breen, 2016; Miller, 2008; Pourahmad, Neshat, & Hasani, 2016; Ramezani et al., 2018; Razmi, Isfandyari Moghadam, & Noroizi, 2013; Seifouri, Babalhavaeji, Fard, & Matlabi, 2018; Town, 2016). All of these studies evaluated and compared the gap between users' expectations of library service and the current state of service delivery, and accordingly made suggestions to solve the problems in the delivery of library services.

### Statement of the Problem

The ultimate goal of any library and information center is to provide the users with the best services. If a library fails to satisfy its users, for whatever reason, it will face complications regarding it actually exists. In fact, without evaluation, it is impossible to speak with certainty about users' (dis)satisfaction with the services provided by the library. Evaluation of the services provided reflects the opinion of the users about and their satisfaction with the current status. However, just being aware of the current status is not sufficient. Identification of users' expectations of the services can help managers optimize the services and make the necessary changes to the current status. Accordingly, the main issue in this study is to determine the difference between the actual, the minimum, and the maximum level of expectations of CLAQR users regarding the quality of the *services provided by human force, information resources, and the physical space available*.

### Research Objectives

The purpose of this research is to identify the actual level of *services provided by human force, information resources and physical space* of the Central Library of Astan Quds Razavi (CLAQR) and to compare it with the minimum and maximum level of expected services. The aim is to make efforts to satisfy users through improving the quality of services and speed of responding to them while identifying satisfactory areas. As complementary to the main objective of the research, the following minor objectives are set out:

- Identification of the actual status of services provided by CLAQR staff from its users' viewpoint and comparing it to the minimum and maximum level of their expectations using the Six-Sigma methodology;
- Identification of the actual status of information resources in CLAQR from its users' viewpoint and comparing it to the minimum and maximum level of their expectations using the Six-Sigma methodology;
- Identification of the actual status of physical space in CLAQR from its users' viewpoint and comparing it to the minimum and maximum level of their expectations using the Six-Sigma methodology;

### Research Questions

Based on the research objectives, the following questions are considered:

- What is the status of services provided by CLAQR staff from its users' viewpoint?
- What is the status of information resources in CLAQR from its users' viewpoint?
- What is the status of physical space in CLAQR from its users' viewpoint?
- What is the general idea of CLAQR users about this library?

### Research Methodology

This is an applied descriptive-survey research to explore CLAQR users' opinion about the center's services in three areas of *services provided by human force, information resources, and physical space*. The standard LibQUAL questionnaire was used to collect the data in this study. This questionnaire identifies and analyzes the gap between the current status and user expectations. The questionnaire has been used in similar studies (Biranvand & Khasseh, 2013); therefore, its validity is confirmed. Calculation of Cronbach's alpha coefficient (0.86) in the work of Najafgholinejad shows that the questionnaire is reliable. Due to the lack of access to the list of users of the center, 372 users over a one-week period were selected as the sample.

Data were analyzed using SPSS 21. The mean and standard deviation (SD) were calculated for the data obtained. In each of the cases evaluated, the calculated SD was compared to the sigma level indicated in Table

1 to determine the qualitative efficiency of CLAQR services. This allows for determining the defect rate in each case of the provided services and taking the necessary action to compensate it.

*Table 1: Efficiency related to the type of Sigma*

Sigma level	Efficiency percentage	Defects per million
6	99.9997	3.4
5.5	99.9970	30
5	99.9770	230
4.5	99.8650	1,350
4	99.3790	6,210
3	93.3300	66,800
2.5	84.2000	158,000
2	69.2000	308,000
1.5	50.0000	500,000
0.92	28.000	720,000
0.51	16.000	840,000
0.22	10.000	900,000

In order to compare the SD obtained for each research question, the actual, the minimum, and the maximum level of expectations were considered. These three levels were quantified in the questionnaire using a 9-point Likert scale so that respondents could better express their views. After the SD of the three levels for each research question is obtained, the difference between the minimum, the actual and the maximum level of expectations can be determined. When the difference is positive, it indicates the users' satisfaction with the provided services, and when the difference is negative, it indicates the users' dissatisfaction with the provided services. The difference between the actual level and the maximum level indicates the utility of the service. Then, the mean of the three levels for each item is compared with the efficiency table related to the sigma type. The compliance of the obtained mean with the above-mentioned table presents the number of sigma obtained. The obtained sigma level determines the efficiency and the number of existing defects. Suggestions can be made for solving the problems based on the defect rate in each case.

**Research Findings**

Descriptive statistics indicators were used to describe the general characteristics of participants (users). Frequency of users was examined based on their gender, education level and visiting period.

*Table 2: Frequency of CLAQR Users based on their gender and education*

	Female		Male	
	frequency	percentage	frequency	percentage
Diploma and lower	69	%30	50	%35.2
Associate degree	78	%33.9	36	%25.3
Bachelor's degree	48	%20.8	37	%26
Master's degree	31	%13.4	14	%9.8
Doctoral degree	4	%1.7	5	%3.5
Total	230	%100	142	%100

The results show that the highest percentage of CLAQR users is related to the users with high school diploma and lower education level (30%), followed by Associate (33.9%), Bachelor (29.8%), and Master

(13.4%). In terms of gender, women accounted for a higher percentage (61.8%) of users. Data on the library users' visiting period is provided in Table3.

Table 3: Frequency of visiting rate of CLAQR users in given intervals

	Frequency	Percentage
Daily	165	%44.35
Weekly	101	%27.15
Monthly	71	%19.09
Seasonal	35	%9.41
Total	371	%100

According to Table 3, 44.35% of the users visited the library on a daily basis, 27.15% on a weekly basis, 19.09% on a monthly basis, and 9.41% on a seasonal basis.

This section presents findings related to the investigation of CLAQR users' opinion about the components of *services provided by human force, information resources, and physical space* of the library at three levels of minimum expectations, actual status (current status), and maximum expectations. There is obviously a significant difference between the minimum and maximum expectation of users. However, it is necessary to examine the possible difference among users' perceptions of the current status, and their minimum and maximum expectations.

***Determination of the difference between the minimum expectation level, the current status and the maximum expectation level of users regarding services provided by CLAQR staff***

Questions 1 to 7 in the questionnaire are related to users' opinion about the quality of services provided by CLAQR staff. Table 4 presents results related to the first research question.

Table 4: Qualitative Efficiency of the Staff in CLAQR.

	Options	Levels	Mean	SD	Mean SD	Sigma level	Efficiency
Q1	Presence of employees who create the sense of trust and confidence	Min	7.01	2.14	2.46	2.5	84.20
		Act	7.29	2.00			
		Max	9.33	2.00			
Q2	Considering each of the users	Min	6.56	2.00	2.30	2.5	84.20
		Act	6.84	2.46			
		Max	9.65	2.46			
Q3	Presence of polite employees	Min	7.63	2.11	2.52	2.5	84.20
		Act	7.29	2.25			
		Max	9.30	3.21			
Q4	Prepared staff for answering to the users' questions	Min	7.29	1.98	1.59	1.5	50
		Act	7.90	1.44			
		Max	8.18	1.37			
Q5	Presence of staff with sufficient knowledge	Min	6.99	2.31	2.03	2	69.20
		Act	7.23	1.91			
		Max	8.69	1.89			
Q6	Presence of kind and interested staff	Min	7.36	2.02	1.75	2	69.20
		Act	6.96	1.90			
		Max	8.12	1.36			
Q7	Presence of staff who understand their users' needs	Min	6.96	2.09	1.78	2	69.20
		Act	7.42	1.75			
		Max	8.83	1.50			



All indicators related to the services provided by CLAQR staff exceeded the expectation level of users, but were below the maximum level. According to Table 2, the indicators of “feeling of trust and confidence in staff”, “courtesy and politeness of staff” and “consideration of each individual user by staff” are in a good status (84.20% qualitative efficiency). The indicators of “sufficient knowledge of staff to answer users’ questions”, “kind and interested staff”, and “presence of staff understanding needs of users” with qualitative efficiency of 69.20% indicate 308,000 defects per million and are relatively acceptable. However, the indicator of “prepared staff to answer user’ questions” with qualitative efficiency of 50% indicates 500,000 defects per million, which is not considered acceptable.

***Determination of the difference between the minimum expectation level, the current status and the maximum expectation level of users regarding information resources in CLAQR***

Questions 8 to 16 in the questionnaire are related to users’ opinions about the quality of information resources in CLAQR. Table 5 presents the results related to the second research question.

*Table5: Qualitative efficiency of information resources in CLAQR*

Options		Levels	Mean	SD	Mean SD	Sigma level	Efficiency
Q8	Easy access to the information	Min	7.14	2.03	1.87	2	69.20
		Act	7.32	1.79			
		Max	7.78	1.80			
Q9	Printed and electronic publications are necessary for my work	Min	6.43	2.44	2.30	2.5	84.20
		Act	6.92	2.22			
		Max	7.25	2.26			
Q10	Availability of required electronic information resources	Min	6.45	2.52	2.44	2.5	84.20
		Act	6.50	2.43			
		Max	7.07	2.37			
Q11	Availability of a website for the center	Min	6.43	2.67	2.51	2.5	84.20
		Act	6.59	2.65			
		Max	7.40	2.23			
Q12	Availability of the required printed resources	Min	6.21	2.61	2.50	2	69.20
		Act	6.25	2.55			
		Max	7.13	2.36			
Q13	Audiovisual materials	Min	5.05	2.83	2.81	3	93.33
		Act	5.59	2.71			
		Max	5.59	2.90			
Q14	Modern facilities to access to the information	Min	6.78	2.18	2.21	2	69.20
		Act	5.95	2.43			
		Max	7.28	2.03			
Q15	Availability of tools for easy access to the information	Min	5.66	2.06	2.05	2	69.20
		Act	6.86	2.30			
		Max	7.31	1.80			
Q16	Access to online resources for resolving the information needs	Min	7.17	2.08	2.10	2	69.20
		Act	6.67	2.31			
		Max	7.49	1.92			

According to CLAQR users, from among the indicators related to information resources and databases, the “audiovisual materials” indicator received the highest score (equivalent to 93.33 sigma), indicating 66800 defects per million. This indicator is in the best status compared to other indicators related to information resources and databases, followed by indicators of “printed and electronic publications”, “electronic resources”, and “library website for finding information resources”, with 158,000 defects per million. Other indicators, with a sigma level of 69.20%, show a defect rate of 308,000 defects per million, requiring more attention from library authorities to improve the quality of the related resources.

**Determination of the difference between the minimum expectation level, the current status and the maximum expectation level of users regarding physical space in CLAQR**

Questions 17 to 20 in questionnaire are related to users' opinions about the quality of physical space in CLAQR. Table 6 presents the results related to the third research question.

Table 6: Qualitative efficiency of the physical space in CLAQR

Options		Levels	Mean	SD	Mean SD	Sigma level	Efficiency
Q17	Availability of a quiet space for the individual activities	Min	7.36	1.80	1.81	2	69.20
		Act	7.22	2.11			
		Max	7.79	2.52			
Q18	Availability of a proper space for study and learning	Min	7.07	2.29	2.10	2	69.20
		Act	6.98	2.22			
		Max	7.71	1.79			
Q19	Availability of a social space for studying and learning	Min	6.42	2.40	2.12	2	69.20
		Act	5.92	2.65			
		Max	7.18	1.32			
Q20	Comfortable and pleasant place	Min	7.20	2.35	2.26	2.5	84.20
		Act	7.32	2.01			
		Max	7.91	2.43			

According to the data in Table 6, from among the indicators related to the physical space, only indicator of “comfortability, pleasantness and attractiveness of the place” with a sigma value of 2.5 (efficiency of 84.20%) is close to the desired level. Other indicators with a sigma value of 2 (efficiency of 69.20%), i.e. 308,000 defects per million, do not show a favorable status. Moreover, in the case of the indicators of “quiet space for solitary activities”, “appropriate and encouraging study space”, and “social space for group learning and group study”, the current status was lower than the minimum expectation level of users, which shows undesirable physical space in CLAQR.

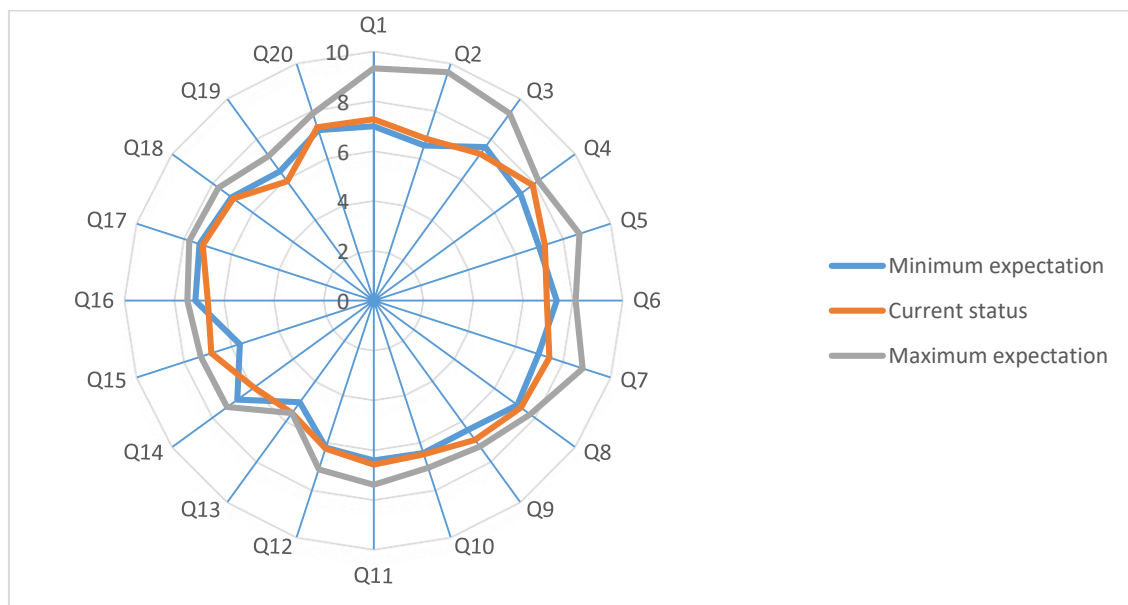


Fig1. Diagram of the current status gap, Min and Max expected level



**General Evaluation of CLAQR Users' Views on the Provided Services**

Questions 21 to 26 in the questionnaire are related to users' opinions about the overall quality of services provided in CLAQR. Table 6 presents the data related to the overall quality of CLAQR. The results of this section correspond to the fourth research question.

*Table7: The overall quality of services provided in CLAQR based on user's view*

	Options	Mean	SD	Sigma level	Efficiency (%)
Q21	The center's contribution to providing timely resources	6.49	2.32	2.5	84.20
Q22	The center's contribution to progress in the favorite fields	6.82	2.32	2.5	84.20
Q23	The center's contribution to understanding the difference between correct and incorrect information	5.91	2.38	2.5	84.20
Q24	The center's contribution to receiving the information skills	6.14	2.32	2.5	84.20
Q25	The center's contribution to learning, research and meeting information needs	6.87	2.04	2	69.20
Q26	User's general views about the CLAQR	6.59	1.98	2	69.20

The SD obtained for users' views on indicators of "timely provision of resources", "helping to advance in areas of interest", "helping to understand the difference between correct and incorrect information", and "helping to acquire information skills" indicates a Sigma level of 2.5, which is equal to efficiency of 84.20% and 158,000 defects per million. A Sigma level of 2, equal to efficiency rate of 69.20% is found for the indicators of "helping the user to learn, research and meet information needs" and "User's general views about the CLAQR", which represents 308,000 defects per million.

**Conclusion**

The research findings show that the current status of all indicators related to human force in CLAQR is higher than the minimum expectations of users. However, the current status is far from the maximum expectations of users. Here, the indicator of "prepared librarians to answer users' questions" had the highest defect rate (50%), i.e. the highest dissatisfaction score. In other cases, an average defect rate of 27.8% is found, which can be improved by removing the weaknesses in order to achieve users' ideal and expected level. These results are in line with those obtained by (Biranvand & Khasseh, 2013). According to their findings from a survey on the Fars Regional Library, the indicator of "prepared staff to answer users' questions" also obtained the lowest satisfaction rate among other indicators related to human force. Therefore, in order to increase the efficiency level and reduce the defect rate, the authorities, in addition to reviewing the information needs of the users, need to increase the readiness of staff to answer the questions of the users and thereby reduce the related defect rate.

The current status of information resources in CLAQR is significantly different from the minimum level of expectations. There is a slight difference only in the case of the "print resources" between the current status and minimum expectations, which can be increased by promoting printed resources. The current status of information resources in this library is highly different from the maximum level of user expectations. Most cases showed a defect rate of 84.20%, which is equal to 158,000 defects per million. The only case where the current status and the maximum level of users' expectations are close to each other is the "audiovisual material" with the lowest defect rate, which accounts for an efficiency of 93.33%, i.e. 66800 defects per million. It is very significant compared to other indicators discussed in relation to the component of information

resources. Biranvand and Khasseh (2013) found an efficiency rate of 99.97% for the compliance of the current status and the maximum level of users' expectations regarding the indicator of "availability of website". Attention to digital information resources has also been observed in (Adam, 2004; Brown, 2005). Nonetheless, in the work of (Cook, 2005), it was shown that the understudy libraries provided the highest level of service quality.

The quality of the physical space of the library was significantly worse than that of the components of human force and information resources. The current status of most of the related indicators was reported to be even poorer than the minimum level of users' expectations. According to users, the current status of only "comfortability, pleasantness and attractiveness of the place" indicator was higher than the minimum level of users' expectations, gaining users' relative satisfaction with an efficiency of 84.20%. In other cases, the efficiency of 69.20% (308,000 defects per million) and the difference in current status and the maximum level of users' expectations indicates undesirability of the current status of physical space and amenities for user. The results of this part of the research are consistent with those of (Biranvand & Khasseh, 2013) indicating low quality of library space. The actual level achieved in the above-mentioned works not only did not meet the maximum level of users' expectations, but also was below the minimum level expected by users. Regarding the physical space of the library, authorities should strive to improve weak points (while maintaining the existing standards) in order to maximize user satisfaction. However, those results contradict the results obtained by (Biranvand & Khasseh, 2013). In general, the rate of 158,000 defects per million and efficiency of 84.20% for general idea of users about CLAQR was satisfactory. Certainly, improving the indicators that led to reduced user satisfaction will contribute to increasing user satisfaction and decreasing defect rate in this library.

### **Research Suggestions**

To improve the quality of services provided by CLAQR, and to reduce the gap between users' expectations and the services provided, the following suggestions are offered:

- Providing the necessary motivation to promote the knowledge and skills of staff;
- Holding workshops on skills related to communication with users;
- Periodic assessment of staff by users and identification of potential weaknesses;
- Providing active awareness-raising services through library updates;
- Increasing the number of e-publications in various subjects;
- Updating printed resources;
- Allocating a place for user's group activities;
- Providing amenities for welfare of users;
- Expanding the interior space of the center and allocating a proper space for formation of study groups and group discussions;
- Providing special services to user-specific groups such as researchers and academics.

### **Conflict of Interest**

No conflict of interests has been reported by the authors.

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