Qualitative and Quantitative Methods in Libraries (QQML) 15, 1:141-165, 2026

Key factors influencing service quality in university libraries in Latin America

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Abstract: This study evaluates the key factors that impact service quality in nine Latin American university libraries that are members of the Z (Z) between 2018 and 2022. Using a Structural Equation Modeling (SEM) approach, the research identifies library space, staff performance, and collections as the main contributors to perceived service quality. The results reveal consistent patterns among users' evaluations and highlight the need for standardized assessment methodologies in the region. These findings contribute empirical evidence to ongoing discussions about library management and user satisfaction in Latin American higher education.

Keywords: Service quality, Library evaluation, Structural Equation Modeling

Received: 17.12.2026 / Accepted: 25.2.2026 ISSN 2241-1925

1. Introduction

The evaluation of libraries offers data on how users make use of them, what types of services they expect, and what types of services can be offered; this information should be used for decision-making (Khoo et al., 2016).

During the COVID-19 lockdown, libraries experienced challenges, such as giving continuity to services without physical spaces and print materials. The measurements carried out in this context enabled the identification of the relevance and worth of those services that remained in operation. This event forced libraries to adjust their services and resources; mainly the offering of electronic resources, the availability of remote services, and the strengthening of synchronous and asynchronous training.

Several authors emphasize the importance of recurring evaluations of the different activities that libraries offer, particularly the importance of the services that patrons directly use. Evaluation is the base for continuous improvement of the library (Almeida et al., 2020; Brito & Vergueiro, 2013; Cuesta Rodríguez et al., 2013; Del Barrio-Tellado et al., 2020; Tavares et al., 2018).

A bibliographic review of publications related to the measurement of service quality in Latin America, from 2018 to 2022, identified a few publications (B et al., 2022); this situation persists. The low number of publications found could be to the fact that, although libraries conduct evaluations of quality and user satisfaction, there may be no established methodology or, if one exists, it may not be published in journals indexed in databases, as is the case in other regions where these studies are more systematically reported (Lázaro-Rodríguez et al.,

2020, p. 4). The findings from the evaluation of quality of service in nine Latin American university libraries, using a Structural Equations Model (SEM) designed specifically for this purpose are presented. The results enable the identification of similar behaviors in the evaluations that users give to the services and resources their libraries offer for knowing the key factors that have an impact on the quality of service.

From these results, it is possible to conclude that library space, staff performance, and collections are the three elements that contribute most to explaining the quality of service and resources that libraries offer.

In the literature evaluating efficiency in university libraries and user loyalty in public libraries, library staff are consistently identified as one of the most critical factors. Tajedini et al. (2020, p. 231) stated that "the human factor and the establishment of mutual relationships in library services are of great importance". Similarly, Tavares et al. (2018, p. 71) asserted that "the greater the number of employees and the better trained they are, the greater the impact of the library on the provision of high-quality services for users". In this sense, these studies conclude that having library skills and experience is a key aspect that will enable staff to offer recommendations and suggestions to make it easier for users to find the information they need.

Other elements that are constantly reported in the evaluation of libraries to attract users and gain their loyalty is the availability of physical spaces that favor individual study, reading and collaborative work (Barfi et al., 2023; Lázaro-Rodríguez et al., 2020; Martin & Lago, 2024). Tajedini et al. (2020, p.

321) stated that “an appealing appearance, interior decorations, and an adequate design of the study rooms are among the factors that can increase client satisfaction”. Furthermore, the availability of separate areas for exchanging ideas, such as think tanks, lounges, and discussion rooms, can also be crucial for attracting users and enhancing their loyalty (Peterson, 2023). Another noteworthy aspect is the library’s role as a social space (Thuannadee, 2022; Twum et al., 2022). Kim (2017, p. 213) suggests that “the academic library is a preferred place to study and spend time during non-class times on campus”.

Matusiak (2012) indicates that the perceptions of usefulness and usability by users, particularly the perceived ease of use, play a vital role in the intention of users to adopt and use digital resources or collections for teaching and learning. Stable-Rodríguez & Sam-Anlas, (2018, p. 255) conclude that “the goal of web accessibility is to permit that webpages are usable by the highest number of persons, regardless of their knowledge or personal abilities and of the technical specifications of the hardware used to access the web”.

The quality of service is a crucial factor that significantly impacts user satisfaction. Soltani-Nejad et al. (2021, p. 3) state that satisfaction is based on users’ expectations and on their understanding of the quality of the services, and therefore, it is a personal and emotional reaction to the services or products of the library. The physical and/or digital collections, the support offered by staff, the facilities and furniture, and the services directly affect the satisfaction of library users (Amanullah et al., 2021).

It is crucial to acknowledge that libraries are in a dynamic context, and they must be aware that they need to adapt and satisfy the information needs of the university community effectively and in a timely manner.

2. Methodology

To measure the quality of services and resources, in some libraries in Latin America the Structural Equations Modeling (SEM) technique is used.

The SEM shown in Figure 1 indicates that service quality, an endogenous latent variable, is explained by the exogenous latent variables: library as a space, access to information, personal search control, and staff performance. Each one of the exogenous latent variables is reflected in behaviors, which are measured by a survey (shown in the Appendix). For each latent variable, a weighted average is calculated using weights obtained through factor analysis and ratings provided by users.

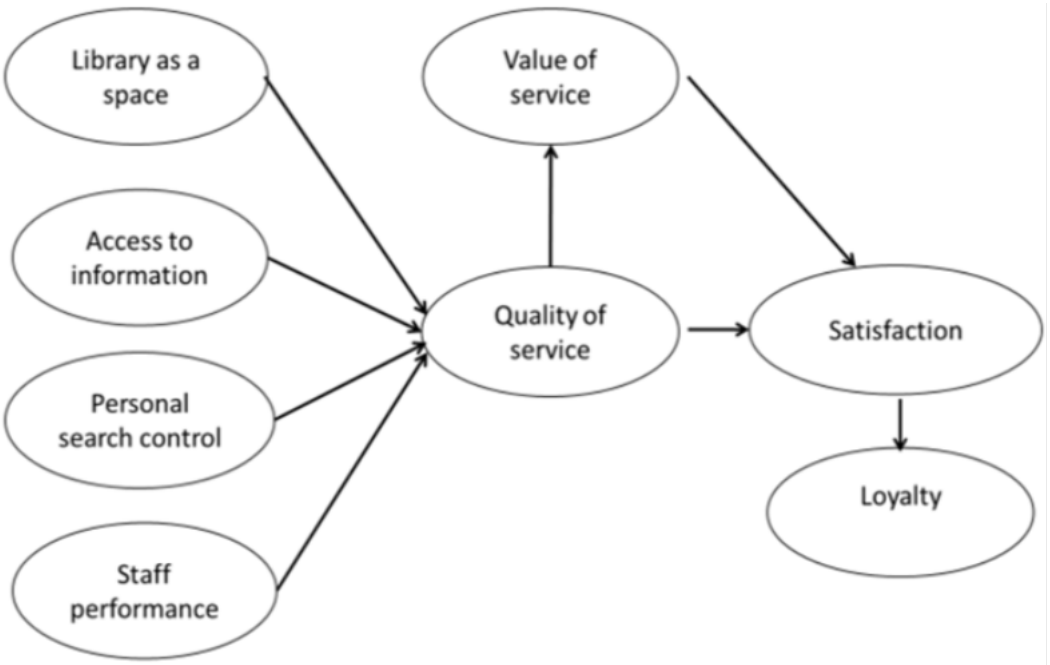
Additionally, the SEM enables the measurement of the proposed relationships between latent variables. These relationships are established under the principle of linear regression where it is possible to prove and measure the linear correlation between the proposed latent variables. For the case of the endogenous latent variable of quality, it is possible to measure the contribution of the exogenous latent variables: library as a space, staff performance, access to information and search control, which are proposed to explain quality.

The manifest variables of the SEM are part of a measuring instrument, shared with the users of the libraries that were evaluated with an online self-

administered survey. The measurement instrument used was taken from the one reported in (A., 2020). The software used for distributing and capturing the answers obtained in the surveys is REDCap (Research Electronic Data Capture). The link to the survey was sent via institutional email to all members of each institution's community. Each institution was responsible for defining the sampling frame, inviting participants, and sending the link and participation reminders.

The evaluation generates quality of service indicator. To do this, those who have used the library's services or spaces must provide a numerical assessment on a 5-point interval scale, where 5 is the highest score.

Figure 1. Structural Equations Modeling for assessing the --- University --- libraries



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The calculation of the SEM by the covariance method requires that there are no missing values. The evaluation instrument is designed to gather feedback on the services, resources, or spaces that patrons use. Thus, the resulting databases contain missing values, which are substituted with values obtained using the MICE (Multivariate Imputation by Chained Equations) tool in R. MICE is a robust and informative method. The procedure imputes missing data in a dataset through an iterative series of predictive models. In each iteration, each specified variable in the dataset is imputed using the other variables in the dataset. These iterations should be run until it appears that convergence has been met (Wilson, 2021). The selection of the MICE tool guarantees that the substitution of missing values does not underestimate or overestimate calculations of estimators. The generation of missing data allows for the calculation of variances similar to those obtained with the data provided by users. In this way, the convergence of the model is achieved without having a substantial alteration of the values obtained.

Table 1 displays information about the evaluated libraries. The application took place in the second semester of 2022, and the number of valid responses varied. In this case, there was an influence of the efforts to promote and communicate the exercise, as well as of the size of the institution and the willingness of the community to participate.

Table 1. Z libraries that participated in the study

Institution	Name of the library	Country	Application dates		Number of valid responses
1	A	A1	9/15/2022 10/7/2022	–	703
2	B	B2	6/27/2022 7/19/2022	–	844
3	C	C3	9/13/2022 10/7/2022	–	830
4	D	D4	6/27/2022 7/19/2022	–	278
5	E	E5	9/9/2022 10/15/2022	–	160
6	F	F6	10/31/2022 12/5/2022	–	228
7	G	G7	11/25/2022 12/28/2022	-	418
9	I	I9	11/24/2022 12/26/2022	–	501
10	J	J10	10/27/2022 05/23/2023	-	355

Source: Original data

3. Findings

Regarding validity, the SEM reports adjustment indicators for the total model. The model was adjusted with EQS 1.6 software using the covariance method. There are different adjustment indicators for evaluating the validity of the model. The ones shown in this analysis correspond, when possible, to the minimum indicators to be reported and which are recommended because of their strength (Kline, 2011). One of these indicators is the CFI Bentler (Comparative Fit Index), which evaluates the relative improvement in the fit of the researcher´s model compared to the base model (independence model). The fit

indexes have been criticized because the assumption of zero covariances among the observed variables is unlikely to be met in most studies (Kline, 2011).

In the nine cases analyzed, the assumption of multivariate normality is not met, and the usual chi-square statistic based on this distribution is therefore biased. Consequently, the estimation was carried out using the robust Satorra–Bentler method, which is recommended for ordinal Likert-type variables (Kline, 2011; Mulaik, 2009).

In Table 2, the CFI values obtained from the model calculations for the evaluated libraries are presented. A value greater than 0.95 indicates that the adjustment of the model is adequate (Kline, 2011). The observed indexes are lower than 0.95, indicating that the obtained samples align with the proposed model to that extent. That is, for the case of the UNISINOS Library the data adjust to the model in 92.5% (0.925), whereas in the José Coronel Urtecho Library, they adjust in 57.5% (0.575).

Another indicator of the model's adjustment is the RMSEA (*Root Mean Square Error of Approximation*), which serves as an adjusted parsimony index. Given two models with similar explanatory power, the simpler model is preferred. The model is considered good if the RMSEA is equal to or less than 0.05. The values for the adjusted model obtained from different samples are below 0.05. For this index, 90% reliability intervals are calculated. An upper limit of less than 0.1 is recommended.

The indicators of the adjustment model reveal that the samples obtained do not fit well with the proposed model. That is, the obtained samples do not adjust the

proposed theoretical relationships in the level that literature indicates. The fit could be improved by including more indicators, especially for the search control variable. Other manifest variables have been considered for reflecting the search control variable, but they have not reached the required weights to be considered indicators that reflect the variance of the latent variable. Thus, they have not been in the analysis. However, it can still be said that the adjustments made are meaningful, particularly when considering the overall fit of the entire model, which assumes independence among scores, exogenous variables, and errors—a condition that is not entirely realistic in many studies. This view is supported by the reliability indicators and the reported coefficient of determination of the endogenous latent variable, shown below. Cronbach's Alpha is used to assess the instrument's reliability, indicating it is adequate for measuring its intended construct. Regarding Cronbach's Alpha it is possible to consider a value of 0.70 in the first stages and values between 0.80 and 0.90 in more advanced stages. Values of 0.60 indicate a lack of reliability (Henseler et al., 2009).

Table 2. Adjustment indicators of the models

Library	CFI of the model	RMSEA	90% interval	Cronbach's Alfa
A	0.925	0.074	(0.062, 0.086)	0.956
B	0.848	0.085	(0.081, 0.088)	0.961
C	0.829	0.103	(0.081, 0.089)	0.95
D	0.872	0.103	(0.096, 0.111)	0.954
E	0.575	0.138	(0.133, 0.146)	0.956
F	0.799	0.105	(0.094, 0.116)	0.922
G	0.884	0.065	(0.056, 0.074)	0.926
I	0.768	0.068	(0.063, 0.072)	0.948
J	0.71	0.072	(0.066, 0.078)	0.942

Source: Original data processed with EQS 6.1

By using the SEM's, the numeric evaluation of the latent variable can be obtained. Table 3 presents the mean and standard error of the latent variables, as measured by the scores assigned to the manifest variables by users. The SME carries out a ponderation considering the score and the weight that each variable obtains after showing the variance of the variable it measures.

All the manifest variables considered in the SEM have obtained weights of at least 0.5, which means that they reflect at least 0.25 (0.5^2) of the variances of the latent variable that they measure. In all nine cases, the proposed manifest variables work well reflecting the latent variables, as well as in explaining the quality of the quality of the services offered by the libraries.

The results enable the identification of similar behaviors in the scores that users give to services and resources offered by their libraries. Considering the scores obtained by each institution, staff performance is the variable that received the highest rating, except in the E Library. Apparently, in the Latin American

context, the attention given to users by library staff is highly valued. In contrast, access to information, which refers to the use of electronic resources and the satisfaction of information needs, shows lower scores than the variables of space and staff performance in most cases, except in the A Library, where it ranks higher. However, it still exceeds the search control variable in six of the libraries evaluated. Search control refers to finding information in the portal of the library. It is clear that an area of opportunity is related to the strategies used by patrons to find information that meets their needs. The standard deviation is small in all cases, which means that the opinion of users is quite uniform within libraries and among regions.

Table 3. Mean of the latent variables that explain the perceived quality

	Library as a space	**Staff performance**	**Access to information**	**Personal search control**
A	4.05 ± 0.02	4.70 ± 0.02	4.10 ± 0.03	4.00 ± 0.03
B	4.05 ± 0.02	4.19 ± 0.03	3.71 ± 0.03	3.45 ± 0.03
C	4.13 ± 0.02	4.37 ± 0.03	3.83 ± 0.02	3.85 ± 0.03
D	4.10 ± 0.04	4.55 ± 0.04	3.84 ± 0.05	3.67 ± 0.05
E	4.15 ± 0.06	4.05 ± 0.09	3.77 ± 0.06	4.21 ± 0.05
F	4.15 ± 0.03	4.58 ± 0.03	3.44 ± 0.03	3.59 ± 0.06
G	4.75 ± 0.02	4.75 ± 0.02	4.44 ± 0.02	4.31 ± 0.04
I	4.36 ± 0.02	4.67 ± 0.02	4.12 ± 0.03	4.05 ± 0.04
J	4.32 ± 0.03	4.57 ± 0.03	4.12 ± 0.03	4.05 ± 0.05

Source: Original data processed with EQS 6.1

Another advantage of SEMs is that they allow for determining the relevance of each latent variable in explaining the quality of the library's services and resources, based on the regression coefficients obtained from the model. The relationships established were statistically significant at the 0.05 level in all nine

cases. As shown in Table 4, patterns emerge regarding the SEM results, which measure the quality of services and resources. Notably, the "library as a space" variable is, in six of the nine cases, the latent variable that contributes the most to explaining quality, whereas "search control" contributes the least, except in one case.

From these results, it is possible to derive that for the users of the Latin American libraries evaluated, library space, staff performance, and collections are the three elements that contribute the most to explaining the quality of services and resources. In contrast, in the D Library Network, the A Library, and the C Library, library spaces do not contribute the most to the explanation of quality.

Today users consider libraries as a meeting space. Searching and the localization of information are not the main activities.

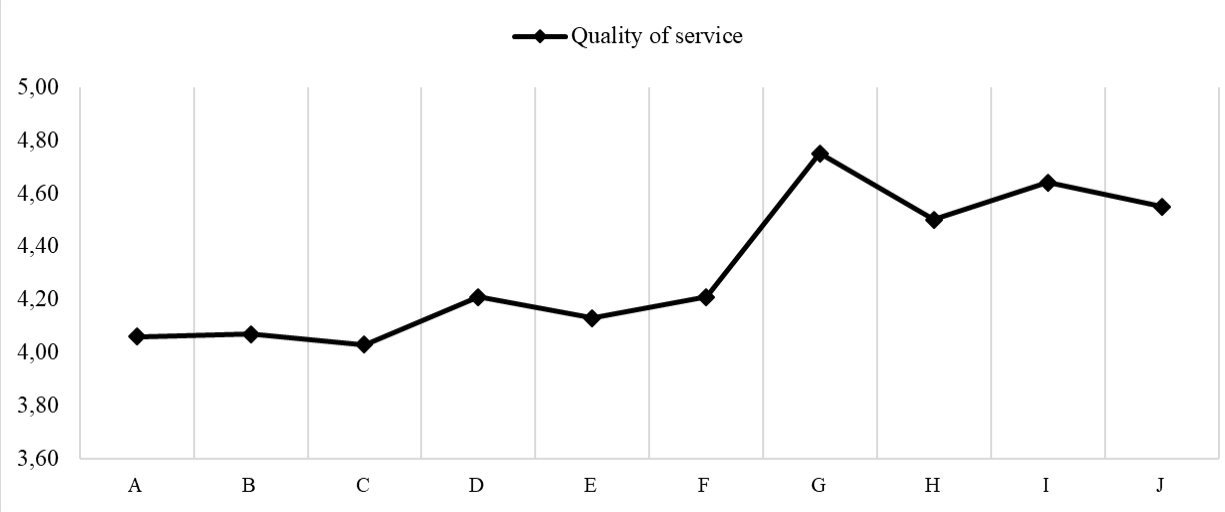
Table 4. The weight of the latent variable that explains the perceived quality

	R^2 latent variable			
Library	Quality	Value of service	Satisfaction	Loyalty
A	0.777	0.521	0.932	0.672
B	0.675	0.668	0.987	0.689
C	0.798	0.696	0.946	0.701
D	0.593	0.753	0.956	0.740
E	0.534	0.793	1.000	0.700
F	0.604	0.512	0.948	0.711
G	0.608	0.606	0.867	0.741
I	0.646	0.738	0.926	0.567
J	0.879	0.713	0.97	0.634

Source: Original data processed with EQS 6.1

The mean obtained for the latent variables that measure the quality in the evaluated libraries is reported in Graph 1. The evaluation of quality considers both the users' experience and their perception of the library's total quality. In this graph, it can be observed that the evaluation of quality is higher than 4 in all cases on a 5-level scale. The quality of services and resources offered by the libraries obtained a good assessment by users. The Dr. Jorge Villalobos library stands out with a value close to 4.8.

Graph 1. Mean of the latent variable quality



Source: Original data processed with EQS 6.1

In previous paragraphs, it is shown that the global adjustment of the model stays under the CFI adjustment indicator, whereas the reliability interval at 90% developed for the RMSEA is close to the criteria indicated in the literature. Another adjustment indicator is the coefficient of determination (R^2) obtained

for the endogenous latent variable quality, which represents the percentage of the concept's variation explained by the manifest variable. Table 5, shows that the percentage of explanation varies in endogenous latent variables. The quality was explained between 53.4% and 87.9%, with the proposed latent variables. This methodology prioritizes parsimonious models, which try to explain a large amount of concepts with the smallest number of indicators.

Table 5. Coefficient of determination R^2 of the endogenous latent variable

Library	R^2 Quality
A	0.777
B	0.675
C	0.798
D	0.593
E	0.534
F	0.604
G	0.608
I	0.646
J	0.879

Source: Original data processed with EQS 6.1

4. Discussion

Recalling Mulaik's (2009, p. 388) perspective on model fit indices overall: "Although the fit tests reveal the failures of these models, the degrees to which they still approximate the data can be useful information to the researcher in determining provisionally whether he or she is on the right track, but should still consider refining the model with more features representing the world to obtain a better fit". The results presented in this article, although they do not report achieving the levels of fit suggested in the literature, nonetheless reflect

progress made in the modeling process. This progress is significant due to the degree of fit achieved, the level of explanation provided by the quality variable, and the consistency observed in user behavior across the nine institutions. The levels of adjustment achieved reveal that this research is still in intermediate stages regarding the identification of manifest variables and their relationships and so it is necessary to continue doing research in order to improve the adjustment levels of the global model.

One of the coincidences observed is the relevance of library staff and their performance. It appears that regarding searching, evaluation, information recovery, and the ethical use of information, library staff play a significant role (Amanullah et al., 2021; Lázaro-Rodríguez et al., 2020; Martin & Lago, 2024). Thus, part of the quality of the services and the resources offered resides with the library staff. In this sense, Tavares et al. (2018) refer to the fact that the higher the number of staff members is, and the better their training, the better the service users receive.

Another consistent result identified in the libraries is that library space is one of the elements that contributes the most to the explanation of quality (Lázaro-Rodríguez et al., 2020; Peterson, 2023; Thuannadee, 2022). The spaces that university libraries offer represent meeting places, spaces for individual and group use, and the space for consulting information, particularly in print format. The measurement of this latent variable considers the evaluation made by users of both group study spaces and individual study spaces, as well as their suitability for studying. The library space has already been considered by

Martensen & Grønholdt (2003) and Soares-Silva et al. (2020), for evaluating library quality. The differences regarding the importance of space in the explanation of quality lie in the context of each library evaluated. Even when these libraries are in the same geographic region, this is vast and diverse.

The efficient localization of information by users is crucial. This study considered the placement of the link to the library in the institutional homepage and the localization of materials in the library. In both cases, there an emphasis on user autonomy. Obtaining lower values in this variable in comparison with the rest of the variables indicates the need to address this element primarily, considering ease of use as a central element for the localization of information in a similar way to the information present in other studies (Matusiak, 2012; Stable-Rodríguez & Sam-Anlas, 2018).

The localization of information also implies the training of users. The lack of training programs that help users know which electronic resources are available fosters the alternate use of internet (Datta & Kumar, 2023), without considering the resources offered.

Since financial, material, and human resources are scarce in university libraries, there is a need for efficient management of these resources to meet the needs considered relevant by users. This is why a systematic evaluation of libraries is essential for continuous improvement (Almeida et al., 2020; Brito & Vergueiro, 2013; Cuesta Rodríguez et al., 2013; Del Barrio-Tellado et al., 2020; Tavares et al., 2018), even more so if indicators are informative, reliable, valid, relevant, practical, and comparable (ISO11620, 2008; Pereira & Varvakis, 2018).

6. Conclusion

The evaluation of university libraries in Latin America through SEM enables the identification of similar evaluations by users regarding the perceived quality of resources and services offered, as well as the relationships between the latent variables.

The university libraries evaluated are similar in terms of their mission statements, user types, geographic regions, languages (except for A Library), and the types of institutions they represent; they are all X institutions with a Christian inspiration. Additionally, it has been identified that library space, staff performance, and access to information are the elements that, for the most part, determine the quality of libraries for their users.

Libraries serve as meeting places for group and individual study, as well as for locating information sources, and even provide a space for rest. Thus, the fact that libraries provide adequate spaces for conducting these activities is relevant to users.

It is also noted that the exogenous variable explaining the quality of the library with the highest accuracy was staff performance, in six of the nine libraries evaluated.

On the other hand, the variable with the lowest score is search control, which refers to the ability to locate information either through the library portal or independently. This result is consistent with the findings reported by Martin and Lago (2024). Significantly, users of six institutions give the lowest score to this

variable. Could it be that the "main entry point" for searching, locating, and using library resources and services is being unattended? Has the creation of a friendly, intuitive, and functional portal been forgotten? Does user training imply finding resources? Or is it a flaw in content marketing?

Even when the results obtained from adjusting the model and the coefficients of determination indicate that the research is currently in an intermediate phase, it is possible to gain insight into users' perceptions of the services and resources that libraries offer. These types of tools enable the identification of strengths and opportunities, with the intention of focusing efforts efficiently and managing them to satisfy the information needs and achieve the missions of the libraries.

It can also be interpreted that the model enables the measurement of concepts with a significant degree of explanation and that all relationships and proposed manifest variables are statistically significant.

It is necessary to continue improving the modeling of this variable, particularly regarding the indicators of search control, which currently consist of only two indicators. The identification of indicators that substantially reflect the variables will contribute to the improvement of the global adjustment. The effectiveness in the calculation of parameters is linked to data recollection. Statistical sampling theory indicates that when a sample is taken, randomness and strata generally favor the efficacy of the calculated values. In our case, the samples were obtained by a self-selection process, which can contribute to the inherent bias of an evaluation that involves satisfaction and dissatisfaction of users. This element has an impact in low levels of global adjustment, which by nature do

not follow a normal probability distribution; a concept underlying global adjustment indicators. The use of robust calculation methods enabled the convergence of the models and the calculation of parameters for the analysis of results that, seen in each segment, contribute to the understanding of user perception.

Acknowledgments

We thank the libraries of the Z Universities in Latin America (Z) that participated in the study and authorized the evaluation using the proposed methodology.

Funding: This work was supported by the Office of Research and Graduate Studies at Universidad X, through the 16th call for applications for funding scientific, humanistic, and technological research projects.

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Appendix

Latent variable	Manifest variable
Filter	Have you used Library X in the last 12 months?
Library as a space	Have you used the spaces of the library?
	To what extent are the spaces offered by the library comfortable?
	How do you rate the environment that the library offers for individual study?
	How do you rate the environment that the library offers for group study?
	To what extent is the library an ideal place for studying?
Search control	To what extent does the library webpage (https://www...) enables you to find on your own what you are looking for?
	To what extent con you find with no help what you are looking for in the library?
Access to information	Have you used the electronic resources (e-books, databases, etc.) of the library?
	To what extent do the electronic databases of the library cover your information needs?
	How do you rate the access to electronic resources (e-books, databases, etc.)
	How do you rate the access to full-text electronic journals through the library's databases?
	To what extent do e-books cover your information needs?
Staff performance	How do you rate the willingness of library staff to help you?
	How do you rate the kindness of library staff when they help you?
	How do you rate the knowledge of library staff to answer your questions?
	How do you rate the orientation offered by the library staff?
	How do you rate the confidence level generated by the staff's demeanor?
Value	To what extent does the library satisfy your information needs?
	To what extent do the services offered by the library help you keep updated?
	To what extent does the library contribute to you daily activities (school, work professional, etc.)?
	Have you used the library's printed materials?
	To what extent do printed books of the library cover your information needs?
Satisfaction	To what extent does the library fulfill your expectations?
	How do you rate your overall satisfaction with the library?
	To what extent does the service in the library resembles an excellent service?

Quality	How do you rate your confidence in the services offered by the library?
	How do you rate your experience in the library?
Loyalty	How do you rate your intention of using the library again?
	How do you rate your intention of saying positive things about the library?
	How do you rate your intention of recommending the use of the library?
Demographics	Age
	Gender
	Indicate the option that best reflects your current status within the University.