

Original Research

Presenting an Evaluation Model of Digital Libraries (Iran)

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Received: 03 July 2024

Accepted: 09 September 2024

Abstract

This article aimed to design and present an evaluation model of digital libraries in Iran, considering the existing and standard models in the world. It is necessary to evaluate the digital library in different design and implementation stages to achieve the predetermined goals and develop digital libraries. The development of a digital library evaluation model mainly aims to evaluate the digital library in multiple ways. It eliminates the weak points, strengthens the strong points, and provides better services in digital libraries. The current research is applied in terms of the objective and a mixed (quantitative-qualitative) type of study. Sources were identified by searching Persian and English databases, and 300 related sources were analyzed in this research. With the quantitative method, an evaluation questionnaire of digital libraries was designed, validated, and completed with the consensus of experts, and then it was sent to digital libraries for completion. The received information was entered into SPSS software. For validity and reliability, exploratory and confirmatory factor analyses and, finally, the model presentation of were done using PLS software. Based on the statistical findings of Cronbach's alpha, convergent validity, reliability coefficient, variance, standard deviation, and pebble diagrams with exploratory factor analysis by rotating the set according to the internal correlation between the items, 13 components were obtained in each element of the item, with significant correlations. On the other hand, no correlation was observed between the items of one factor and those of another. Then, the digital library evaluation model was developed in the confirmatory factor analysis, which led to identifying 13 components (information link, architecture, information retrieval, new technologies, users, user-friendliness, applicability, information exchange, information, communication, updating, user security, and information coverage). According to the obtained findings and pattern, this pattern can be used to examine and evaluate digital libraries.

Keywords: Digital Library, Digital Library Evaluation Model, Iran.

Introduction

With the ever-increasing expansion of the virtual world, activity in the web environment has become essential for libraries and information centers. Additionally, the increasing expansion of digital publishing and the elimination of the mechanism and use of information necessitates using the resources of libraries and information centers, publishing on the website, and providing information through the Internet in this field. This goal requires developing web-based services compared to other information providers and synchronization or information technology for all coffee shops (Saeidnia, 2019).

To achieve development goals in any country, necessary changes are first essential in the information system of that country. The government's information system needs to have a digital library that is structured and scientifically developed to keep up with the world's modern technology. The development of digital libraries is not possible only by providing appropriate software and hardware infrastructure because the use of information technology in libraries and the creation and development of digital libraries are complex processes involving many technical and non-technical factors. The use of up-to-date library standards in the world to exchange information between libraries, organize resources in digital libraries, and be a member of the content supply consortium in the country for digital libraries in Iran are among the key factors that improve library performance while saving costs. The digital issues of Iran are expanded in the topics of the collection. The development of digital libraries is significant in two ways. The first dimension, horizontal development, is dedicated to quantitative expansion and increasing the number of digital hub libraries. From this point of view, development requires efficient infrastructure and capital costs. The second dimension of the development of digital libraries deals with quality (Hariri & Norouzi, 2011).

Undoubtedly, suppose the library's website has a structure that allows easier access to information and more appropriate interaction with users. In that case, it will increase the use of the considerable amount of electronic resources that have been prepared and organized at a great expense (Norouzi & Jafari Far, 2018). Digital libraries have the potential to become global repositories and communication channels for the future, a typical means by which everyone can access information, discuss, evaluate, and promote digital library technologies (Thanos & Casarosa, 2017). The world's first digital library was founded by Michael Hart in 1971. As a student at the University of Illinois, he launched "Project Gutenberg" to make as many free electronic books as possible with expired copyrights available. This project was the first site containing information on the Internet and the first digitized library worldwide (Mittal & Mahesh, 2008).

The first digital library started in Iran in 2004, and the Tehran International Research Institute launched Iran's first digital library in international relations. Essential elements in the design of a digital library are full-text resources (digital resources), unique users, reliable and stable access to resources, resource format (presentation of resources in different forms of text, image, map, video, and video and audio), search and retrieval, collection building, expert human resources, development of infrastructure and equipment, organization (listing, classification, and even indexing), ability to collaborate with other libraries, and interoperability of collections, reference services, and printed resources along with digital resources, standards, and standardization, and respecting intellectual property.

Various evaluation tools have been produced to evaluate and measure the quality of the work of these libraries, which can be used to measure digital libraries. The six main tools for

assessing the quality of digital library services include the DigiQual model, WQET model, PanjS model, Delos comprehensive model, Kano model, and E-QUAL model. Each of these models evaluates and investigates criteria such as content, performance, credibility, up-to-dateness, link, graphic, structure, user, operation, quality, policy, architecture, etc. In the digital library world, good work has been done in the field of digital library models and providing a solution and a framework for the standard of scientific research (Samiei & Mogharabi Manzari, 2023).

Literature Review

Samii and Mogharabi Manzari (2023) have assessed the risks of specialized skills of human resources of digital libraries at public universities in Tehran based on the ISO 31000 standard. This research indicates that among the 18 risks of specialized skills of the human resources of digital libraries, the risk of having the necessary knowledge regarding the languages and tools of the semantic web is the priority of the risks. This point shows that the human resources of university digital libraries are not in a favorable condition regarding current knowledge and new information technologies, the semantic web that is the basis of ontologies, linked data, etc.

Al-Akbar and Jafarzadeh Kermani (2023) measured the level of users' satisfaction with the efficiency of the Astan Quds Razavi digital library. The results showed that respondents' satisfaction with the efficiency of Astan Quds Razavi digital library was higher than the average level and close to the desired level. In their case study, Aloklu and Al-Amri (2021) evaluated a digital library in a higher education institution providing services to 75,000 students. The results showed that online journals and reference sources were the most and least used items. They conclude that the usability and information retrieval capacity are good. However, there is a need to improve the user interface of the digital library and create more awareness and subscriptions to online journals to meet users' needs. Anser, Tabash, Nassani, Aldakhil & Yousaf (2023) investigated the role of electronic service quality and trust in achieving electronic loyalty among digital library users. The results showed that the quality of electronic services could positively affect electronic trust in the digital economy; in addition, electronic trust created electronic loyalty in digital library users.

Shahzad and Khan (2023) studied factors affecting the acceptance of semantic digital libraries and tried to identify challenges facing implementing semantic technologies in digital libraries. This study aimed to provide practical solutions for the efficiency of digital library systems to provide richer data and services to users. The findings show that semantic digital libraries are vital because they provide information resources. Interoperability of systems advances in two-way transfer modules, machine-controlled indexing, and folksonomy were key factors in developing semantic digital libraries. Five challenges were identified for creating a semantic digital library system, including ontology and interoperability, development of a suitable model, diversity in language, lack of skilled human resources, and other technical issues.

Kreutz, Blum, Schaer, Schenkel, and Weyers (2023) evaluated digital library search systems using formal process modeling, usually focused on users who perform pre-defined tasks correctly and quickly. In addition, they enjoyed working with an evaluated system and completed questionnaires that demonstrated the user interface experience. Such evaluations do not consider the comparison or correlation of the user's information-seeking behavior with the capabilities of the digital library system and ignore the user's actual needs. The research claims that formalizations are appropriate and helpful in reflecting strategies to users and comparing

the ideal tasks of users with the capabilities of information systems. Using formal methods for qualitative digital library studies is a suitable way to identify current limitations and draw a strategy for performing user tasks.

To carry out this project, there are currently models for evaluating digital libraries, each with a specific framework and limitations. In these models, there are similar standards that overlap each other, as well as basic standards and important indicators in one model that are ignored in another. This is the point at which there is a need for a comprehensive model that can meet the essential criteria of several application models while combining similar criteria. Such a model can evaluate the digital library from multiple aspects while eliminating the weaknesses and strengthening the strengths to provide better services in digital libraries.

A review of past research shows that there is unfortunately no integrated and useful measurement tool for evaluating digital libraries. Therefore, having an integrated tool for measuring and assessing the quality of digital libraries is more necessary than ever. Removing the weak points and strengthening the strong points will further provide the development and progress of digital libraries as much as possible. This research mainly aims to identify the components of digital library evaluation and a native model design suitable for digital libraries.

Materials and Methods

The current research is applied in terms of purpose and of a mixed type (qualitative-quantitative) study. It uses a qualitative approach in the design stage of the conceptual model and a quantitative approach in the explanation stage of the questionnaire, seeking to present a new model for evaluating digital libraries. The results of this research can be used for all digital libraries in Iran. The first stage includes searching in print and digital libraries, searching and examining the internet and online international databases (Google Scholar, Emerald, Science Direct, Scopus, and Web of Science), as well as the publications and internal websites of IranDoc and Magiran, to collect information about the identification of the evaluation components of digital libraries. For this purpose, about 680 documents related to the keywords were searched by reviewing the mentioned items. Among the searched documents, 300 relevant documents were analyzed for their content, and the questionnaire design was extracted and carried out based on the components mentioned in the analyzed texts and sources. The main tools for data collection were a checklist and a check sheet to determine the main components and indicators.

The questionnaire questions were designed based on numerous corrections and controls on the components and sub-components. The data collection tool in the quantitative phase was a researcher-made questionnaire consisting of 13 elements (Figure 1) and 68 questions, designed based on the initial conceptual model. This questionnaire's answers were designed based on a five-point Likert scale using a range of appropriateness. These components include information links (communication links), architecture (structural design), information retrieval (access to information), new technologies (electronic equipment), users (users), user-friendliness (user satisfaction), applicability (generalization ability), information exchange (information transfer), information, communication, updating, user security (information preservation), and information coverage (information comprehensiveness).

Delphi technique and the consensus of professional experts (30 experts in information science and epistemology) were used to confirm the researcher's questionnaire. Using this technique, each expert was asked in three stages to rate each indicator based on the Likert scale.

The amendments and the working process of the questionnaire were approved by 25 people in the first stage), 25 people in the second stage, x, and 15 people in the third stage.

The content validity was tested quantitatively using two relative coefficients of content validity (CVR) and content validity index (CVI). It was calculated by summing up the agreeable points for each item that obtained a relevant point but needed to be reviewed. It was utterly appropriate to divide the total number of experts by To determine CVR; experts were asked to assess each item based on the three-part spectrum of "necessary," "useful but not necessary," and "not necessary." Then, the answers were calculated according to the formula, and the wording and order of questions were modified based on the experts' suggestions, which were used to examine the tool's validity by approving the items with a calculated CVR of more than 50. The reliability of the questionnaire was assessed using Cronbach's alpha method. After collecting the questionnaires and performing the necessary calculations to implement the process as mentioned earlier, the reliability of all the variables was found to be more than 0.7, confirming the reliability of the questionnaire.

After going through these steps, a questionnaire was made in two ways: online by manually sending the link of 350 questionnaires to the statistical community (digital libraries) between March and April 2023-2024. After several follow-up steps, all the information from 303 returned questionnaires was entered into the SPSS 24 software. In the second stage of the research, the structural equation modeling method and PLC software were used to fit the model, which includes two essential outputs, t-statistics and path coefficients (factor loadings). Finally, the fit of the obtained model of 12 valid factors in digital library evaluation was extracted through varimax rotation, finally presenting the digital library evaluation model. In general, the current research pursued the path of determining the goals, analyzing the content of the texts, extracting the components, designing the questionnaire, examining the validity and reliability of the questionnaire, fixing the shortcomings of the questionnaire, implementing the questionnaire in the statistical population, fitting the model, and finally analyzing the results.

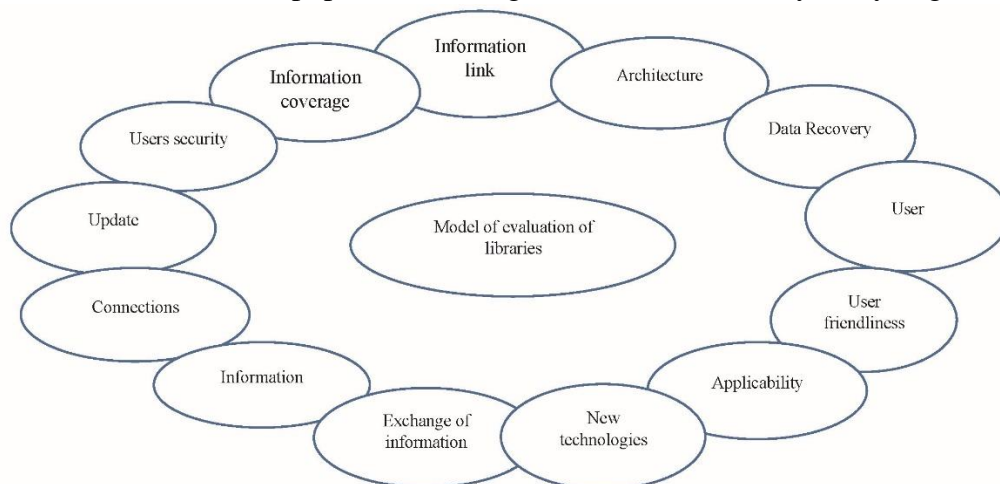


Figure 1: Model of evaluation of libraries (Digiiran)

Results

After collecting the data and information, descriptive statistics, including central and dispersion indicators (e.g., frequency percentage, graphs, and tables,) were used to describe the data results. Demographic variables in this research include gender, age, education level, etc.

In the studied sample, 54.8% and 45.2% were women and men, respectively, consisting of users (72.3%), librarians (17.8%), and employees (7.9%). Moreover, bachelor's degree (47.9%), postgraduate (43.2%), and doctorate (only 8.9%) were the participants' education levels. According to Table 1, the Kaiser-Meyer-Olkin (KMO) statistic value (0.892) indicates that the data are suitable for factor analysis. The significant result of Bartlett's test also shows that the correlation matrix between items is different. This means that there is a high correlation between the items within each factor on the one hand, and there is no correlation between the items of one factor and the items of another factor on the other hand.

Table 1

KMO statistics (Kaiser-Meyer-Olkin index) in the research of presenting the digital library model

KMO sampling suitability criteria	0.892
Approximate Bartlett's test	10850.751
Degrees of freedom	1953
The significance level	0.001 >

The exploratory factor analysis in SPSS was used to identify the evaluation components of the digital library and a native pattern design. Based on the KMO index result (0.892), the research questionnaire data can be reduced to a number of basic and fundamental factors.

The eigenvalues of the extracted factors are rotated to discover each factor's contribution to explaining the variance set of all the items. In this test, factors 1-15 have an eigenvalue greater than one, and the first factor explains 9.722%, the second factor 6.647%, etc. of the variance. The sum of the variances shows that this questionnaire can explain about 67% of the total variance of digital library evaluation.

In the column of initial values, the initial eigenvalues for each factor are estimated as the sum of explained variance, expressed in terms of the percentage of total variance and cumulative percentage. The characteristic value of each factor is a proportion of the total variance of the variables explained by that factor. The eigenvalue can be calculated by dividing the squares of factor loadings related to all the variables in that factor. Hence, the eigenvalues show the exploratory importance of the factors concerning the variables.

The low value of this value for a factor means that that factor has a small role in explaining the variance of the variables. The explained variance of the factors with eigenvalues of > 1 is presented in the column sum of squares of factor loadings. The squared values extraction value column shows the set of values of the extracted factors after rotation, indicating that 15 factors can explain the variances if the obtained factors are rotated with the varimax method.

The correlation coefficient matrix between factors after rotation shows that each variable is placed in a factor showing a significantly high correlation with that factor.

The pebble diagram (Figure 2) determines the optimal number of factors. According to this graph, the changes in the specific value decrease from the fifteenth factor onwards; hence, 15 factors can be extracted as the crucial factors that explain the data variance.

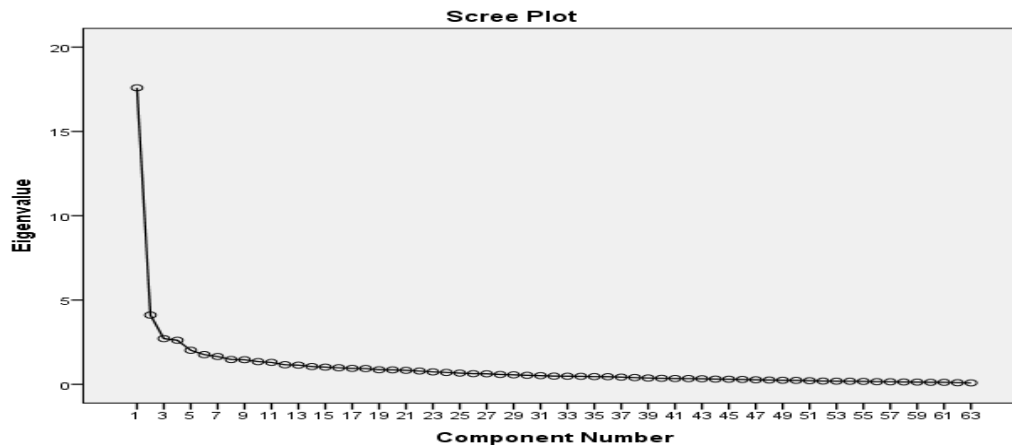


Figure 2: The pebble chart to determine the number of factors used in the research of presenting the digital library model

The calculated value of Cronbach's alpha coefficient for all components indicates that they have acceptable reliability. Moreover, the calculated value of the combined reliability coefficient for the components is more than 0.7 for most of the factors. Therefore, the variables have acceptable reliability.

The confirmatory factor analysis is used to answer the research question: what is the validity of each of the features identified in the evaluation model of the digital library and the native model plan? The reliability of a tool is its degree of stability in measuring whatever it measures, that is, to what extent the measuring tool gives the same results under the same conditions. The questionnaire's reliability is evaluated using one-dimensionality indexes, such as Cronbach's alpha and composite reliability, and its validity is measured with the convergent validity index. If the Cronbach's alpha of a block is more significant than 0.7, it is a one-dimensional block (Azar, Gholamzadeh & Qanawati, 2012: 158). Considering that Cronbach's alpha provides a stricter estimate of the internal consistency reliability of underlying variables, another measure called composite reliability is used in structural path models when this value is more than 0.7 of that one-dimensional block. The model's validity is evaluated with convergent validity, which means that the set of indicators explains the main structure (Azar et al., 2012: 162). Fornell and Larcker (1981) suggest using average variance extracted (AVE) to measure convergent validity. A minimum AVE equal to 0.5 indicates sufficient convergent validity, which means that an underlying variable can explain more than half of the dispersion of its indicators on average. Valid and reliable estimates of the measurement model allow the evaluation of the structural model. The four essential criteria of the coefficient of determination (R^2) and predictive correlation are used to evaluate this model, as examined in the following. The R^2 is the essential criterion for assessing endogenous variables. In structural modeling, values equal to 0.35, 0.15, and 0.02 are described as significant, moderate, and weak, respectively (Azar et al., 2012: 167). The AVE values calculated for the components (Table 2) indicate that almost all components have an acceptable convergent validity.

Table 2

Convergent validity values of the factors involved in the components of the research of presenting the digital library model

Component	AVE
Information link	0.579
Architecture	0.491
Data Recovery	0.515
New technologies	0.648
Users	0.542
User friendliness	0.493
Applicability	0.687
Exchange of information	0.549
Information	0.606
Connections	0.806
Update	0.721
User security	0.618
Information coverage	0.731

The results in Table 3 show a significance between the components; thus, it can be concluded that there is a relationship between the factors, the digital library, and the native pattern design.

Table 3

The prediction model of the digital library and native pattern design in the research of presenting the digital library model

	Path coefficients	Sample mean	Standard deviation	Statistic	P-value	R ²
Digital Library -> Information link	0.818	0.817	0.023	35.291	0.001>	0.669
Digital Library -> Architecture	0.832	0.833	0.019	44.028	0.001>	0.693
Digital Library -> Information retrieval	0.730	0.730	0.036	20.374	0.001>	0.533
Digital library -> new technologies	0.644	0.646	0.039	16.494	0.001>	0.414
Digital Library -> Users	0.690	0.692	0.036	19.275	0.001>	0.476
Digital library-> user-friendliness	0.765	0.767	0.030	25.177	0.001>	0.585
Digital library-> Usability	0.696	0.697	0.032	21.768	0.001>	0.484
Digital library-> information exchange	0.587	0.589	0.048	12.258	0.001>	0.345
Digital Library-> Information	0.396	0.400	0.056	7.026	0.001>	0.157
Digital Library-> Communication	0.540	0.538	0.060	8.965	0.001>	0.291
Digital Library-> Update	0.585	0.586	0.039	14.920	0.001>	0.342
Digital library-> user security	0.650	0.651	0.036	18.238	0.001>	0.422

	Path coefficients	Sample mean	Standard deviation	Statistic	P-value	R ²
Digital library-> information coverage	0.446	0.448	0.054	8.249	0.001>	0.199

The quality of the measurement model was assessed using the subscription validity index or CV_com or the same. If the validity check index of hidden variables is 0.35, the measurement model has good quality. The subscription validity index values are given in Table 4. According to the values in Table 4, the measurement model has the appropriate quality. The value is less than 0.35 in the two information and coverage components, with values higher than 0.02 as an average value.

Table 4

Evaluation of the quality index of model data related to the components in the research of presenting the digital library model

Component	Subscription index (f^2)
Information link	0.202
Architecture	2.252
Data recovery	1.140
New technologies	0.708
Users	0.910
User-friendliness	412.1
Applicability	0.938
Information exchange	0.527
Information	0.186
Communications	0.411
Update	0.521
Security of users	0.731
Information coverage	0.248

Figures 3 and 4 show the graphs of path coefficients and the value of the t statistic.

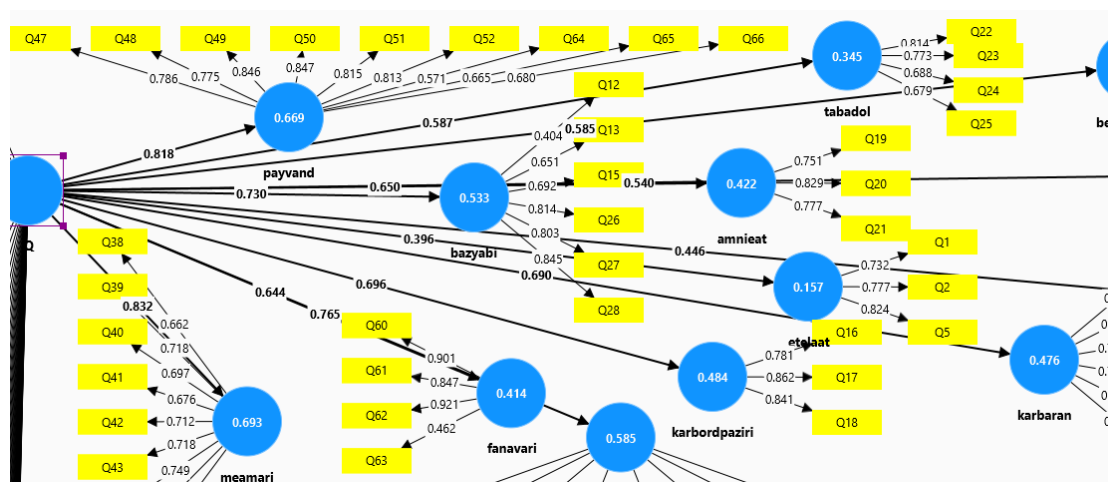


Figure 3: The chart for determining the route coefficient in the research of presenting the digital library model

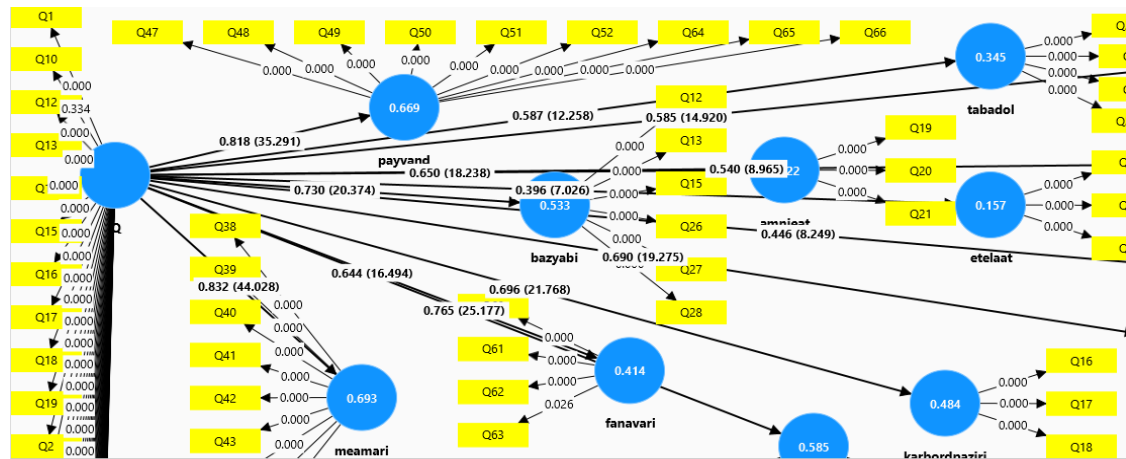


Figure 4: The *t*-statistics determination chart in the research of presenting the digital library model

Discussion

The results show a relationship between the components and the evaluation of the digital library according to the main goal of the research, which is the appropriate model of digital libraries in Iran. The quality indicators of the model also confirmed this. From the findings of this research, it is concluded that there is a significant relationship between all the components of library evaluation, and the components and questions have acceptable reliability and convergence.

Finally, the results show that this questionnaire can be used to evaluate digital libraries.

Simplicity in searching for texts and execution, an attractive and stylish format, the possibility of a more straightforward and faster presentation, and the ability to add multimedia features are among the features that distinguish the digital library as a growing medium from other media of this kind. The promotion of science by libraries facilitates the expansion and development of science and the accessibility of information and knowledge to different strata of society. With the current existence of information and communication technologies in libraries, the exchange and sharing of scientific information help advance science. Digital libraries in a new form with the ability to pay attention to quantity, occupy less space, update quickly, have no time and place restrictions for providing information, and have a unique role in developing the goal of information dissemination. They also create a suitable and favorable environment for the cycle of science. The digital libraries are based on the information-seeking behavior, thematic priorities, needs, and unique characteristics of users. A digital library should be able to provide the information requested by the users, be effective in the direction of scientific progress and the guidance of the users' requests, and strive to promote social diversity and the richness of emerging developments.

Similar to the goals of this research, Shahzad and Khan (2023) investigated the factors affecting the adoption of semantic digital libraries to identify the challenges facing the implementation of semantic technologies in digital libraries. To provide practical solutions for the efficiency of digital library systems to provide richer data and services to users, five different challenges, including ontology and interoperability, development of a suitable model, diversity in language, lack of skilled human resources, and other technical issues, were identified to create a semantic digital library system.

In an investigation of digital libraries and distance education services, Habibi and Salami (2023) introduced the digital library reference model, which considers policy, content, and

architecture as the three main concepts of the critical success factors of digital libraries in open distance and digital education. These three concepts are compatible with the current research. In a study on library evaluation models, Norouzi, Abbasi, and Heidarnia (2019) examined the model used to evaluate libraries, among which four models (DigiQual, EQual, FiveS, and Kano) are considered in the current research, which is consistent with our research.

Turkashvand et al. (2021) classified the quality of digital library services into four main factors: internal, external, third factor, and output service quality. The internal factor has two sub-components of standards and procedures; the external factor includes emotional appeal, usefulness, ease of use, relevance, usability, and reliability, and the third factor consists of the ability to explore, website design, information access, privacy, etc. The quality of output services includes the quality of information, responsiveness, and communication. Similarly, these sub-components exist among the components examined in this research. Anunobi and Azeani (2011) investigated the development of digital libraries at universities in developing countries. Their findings revealed the main characteristics of digital libraries, including content, user, performance, policy, quality, technology, and personnel, which are comparable and consistent with the current research.

Conclusion

This research examined six digital library evaluation models, including DigiQual, WQAT, Delos, Kano, 5 S, and EQual, to provide a rich model for evaluating digital libraries with a combination of models. In the work method, content analysis and Delphi panel were used to prepare the questionnaire, which was assessed through final approval steps to achieve the six main components, *viz.* information, usability, users, architecture, graphics, and new technologies, with 68 questions. After the questionnaire's final design and reliability and validity, it was given to users (active users, librarians, active employees, and professors) both online and manually. After collecting the questionnaires, their data were entered into SPSS software, followed by confirmatory and exploratory factor analysis and model fitting. After receiving 303 questionnaires from the statistical population of the research and entering their information into the software, the results of the demographic variables indicated that 45.2% and 54.8% of the sample were men and women, respectively. The statistical population consisted of users (72.3%), librarians (17.8%), employees (7.9%), and professors (only 2%).

The components of information link (nine questions), architecture (nine questions), information recovery (six questions), new technologies (four questions), user (six questions), user-friendliness (seven questions), usability (three questions), information exchange (four questions), information (questions), communication (two questions), update (three questions), user security (three questions), and information coverage (two questions) in the questionnaire were significantly correlated with the correlation factor.

The components' alpha coefficient had acceptable reliability, and the estimated combined reliability coefficient was more than 0.7 for most of the factors. Thus, it can be concluded that the variables have adequate reliability, and almost all the components have acceptable convergent validity (AVE). In the prediction model of digital library and components, the results showed a significance between the components, hence it can be concluded that there is a relationship between the factors, the digital library, and the native pattern design.

The quality of the measurement model was assessed with the subscription validity index or CV_{com}, indicating the appropriate quality of the measurement model. The value is less than

0.35 only in the two information and information coverage components, with average values of higher than 0.2. Exploratory factor analysis in SPSS was used to determine the influencing factors and characteristics and identify the components' characteristics. Since the value of the KMO statistic was equal to 0.892, the data were suitable for factor analysis. Furthermore, the significant result of Bartlett's test shows that the correlation matrix between items is not the same. This means that there is a high correlation between the items within each factor on the one hand, and there is no correlation between the items of one factor and those of another on the other hand.

The prediction model of the digital library and components showed a significant relationship between the components. Thus, it can be concluded that there is a relationship between the factors, the digital library, and the native pattern design. The obtained model can review and evaluate digital libraries according to the findings.

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