Impact of online interactivity dimensions on library website quality

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The paper seeks to investigate how far the interactivity dimensions - as proposed by Ha and James (1998) and empirically validated by Chen and Yen (2004) using business websites - are applicable to library website. It also attempts to frame an online interactivity model, depicting the effect of interactivity dimensions on library website quality. The analysis revealed the way interactivity dimensions affects quality of website and the study suggests that the four interactivity dimensions - reciprocal communication, connectedness, information collection, and playfulness - have considerable impact on the quality of library website. The online interactivity model deduced from the study will help librarians to determine the relationships of four independent variables (dimensions of interactivity) with the dependent variable (website quality). The findings will help researchers, librarians and web developers alike to measure qualitatively the effect of interactivity dimensions on library website quality which will guide them in developing an interactive library website to attract users towards the library.

Keywords: Academic libraries; online interactivity; web 2.0; website quality

Introduction

In the present world, websites are being used as prime media of communication to the outside world. Acknowledging the need and usefulness of website, social, commercial and entertainment sectors have long been engaged in developing web-based information communication systems[1]. With internet being the primary source of information, the distinctiveness of the libraries is gradually diminishing. To be relevant in the present day context, libraries need to go beyond their physical boundaries and working hours, to potentially expand library services and facilities to users located far-off[2]. This necessitates libraries to use websites as means to provide access to information resources, online catalogues, news and events, besides providing information about library collection and facilities. However, merely having a website will not attract much of their users; they need to create such websites where users enjoy interactive experience and get into high quality online exposure that too in consonance with the rapid growth of online tools and ease of access to online resources. Therefore, libraries using their websites for web-based library resources, interactive website quality may be a major factor for the enhancement of library facilities and services. Online interactive features ensure users' involvement with the library website, improves its information and communication quality, and develop 'cognitive and social connection between users and librarians'[3]. Therefore it is essential to have an idea about the dimensions of online interactivity so that websites can be designed and developed in such a way so as to facilitate interaction between the website and library users. Several researchers have developed measuring instrument and tested website quality[4] and reported that quality of website to be a multi-dimensional construct[5,6]. Users experience with the website has to be a fruitful one, to ensure their revisit. This necessitates a quality website to be heavily dependent on, online interaction between the user and the site[7].

Literature review

Interactivity has been defined variously by various authors. According to The Oxford English Dictionary Interactivity "pertains to or being a computer or other electronic device that allows a two-way flow of information between it and a user, responding immediately to the latter's input". Sohn and Lee[8] opined that human perception of interactivity centers around the extent of effects of interactive media on individuals. According to Refaeli and Sudweeks[9] interactivity is not a characteristic of the medium. It is a process-related construct about communication". A more straightforward definition of interactivity has been given by Chen, *et al.,*[10] as "consumers' perception of their interaction with the medium".

There is a lot of confusion to gauge the dimensional characteristics of interactivity[11]. Rafaeli[12] argued that interactivity is a unidimensional construct and depends on the extent at which messages are sequentially related.

His study mainly focused on the mechanical aspect of interactivity rather than functional approach. On the contrary, some researches on interactivity provide empirical evidences to prove that online interactivity has many components[13,14,6]. They all agree that web designers should focus on the usability aspect of a website, but most of the studies being exploratory, paid little attention to empirically proving the multidimensional nature of online interactivity[15].

Laurel[13] suggested that interactivity has three dimensions—frequency, range, and significance. Steuer[16] also concentrated on tri-dimensional construct of interactivity - speed, range, and mapping. Coyle and Thorson[17] conceptualized three important components of website interactivity - mapping, speed, and user control. The above constructs put more emphasis on the functional approach of interactivity rather than its perceptual angle. Ha and James[14] opined that users must interact with the website effectively and efficiently to get successful online session. They further suggested that users' perceived level of engagement with the website depends on the extent of communication that users need to experience with the site. Based on the degree on user-website communication level they identified five dimensions of online interactivity–playfulness, choice, connectedness, information collection, and reciprocal communication. However, while studying online interactivity from quantitative angle, Downes and McMillan[6] forwarded six dimensions: way of communication, flexibility of time, place of activity, extent of control, responsiveness, reason of communication. These dimensions, compared to that of Ha and James, are arguably more quantitative in approach, with little emphasis on user's perceived involvement with the website in relation to interdependence, coordination and understanding.

Previous researches have enriched the understanding on the dimensions of online interactivity and the use of various web-based applications in library. However, very little attention was given to finding any association of online interactivity dimensions with the library website quality. Additionally, research has yet to explore any interactivity model to measure the impact of each of the components of interactivity on website quality. In the present study, attempt was made to examine the five interactivity dimensions, as proposed by Ha and James[14], against website quality to identify online interactivity dimensions impacting on library website quality and more importantly, to frame an interactivity dimension model so that

website designers and library professionals can measure the effect of changing variance in online interactivity dimensions on library website quality.

Objectives of the study

- To study how far the interactivity dimensions, as proposed by Ha and James[14], are relevant to library website
- To frame an online interactivity model; and
- To investigate the extent of effect of each of the interactivity dimensions to the library website quality.

Formulation of research hypothesis

Hypothesis can be defined as a proposition, stated in a testable form and predicts a particular relationship between two or more variables[18]. Taking a cue from the investigation of Chen and Yen[15] on commercial websites, attempting to validate Ha and James[14] five interactivity dimensions, the present study was conducted and following research hypothesis were formulated to find relationship between the library website quality and online interactivity.

Playfulness

It is a sort of entertainment that increases association of users with the website. Introduction of attractive features in website ensures users revisit the site and therefore playfulness is considered as one of the key factors for online interaction. Thus the following hypothesis can be framed:

Hypothesis 1: Online playfulness features are positively correlated to library website quality.

Choice

It refers to the degree of preference of users to access and interact with the website. Consequently, the site providing options for viewing in different browsers, having printer-friendly page layout, offering different sorts of navigational tools and customization features will enhance user's choice, leading to the following hypothesis:

Hypothesis 2: Choice is significantly related to library website quality.

Connectedness

The perception of connectedness can be improved if a website offers multitude of functionalities in tune with users' requirement making them socially close with the website. Application of video and audio clips

of events, providing online social platforms to exchange views and share ideas will trigger up the feeling of connectedness. Accordingly following hypothesis has been drawn:

Hypothesis 3: Connectedness is a strong predictor for library website quality.

Information collection

Providing information to the users is one of the main objectives of any website. It refers to different ways users are updated with relevant information. Hence the following hypothesis has been surmised:

Hypothesis 4: Method of information collection is a significant contributing factor to library website quality.

Reciprocal communication

As the name suggests it is a both way communication– library staff to users and vice versa. It refers to communication through online chat, email, bulletin boards, survey form, comments/feedback form, etc. Thus it is assumed that:

Hypothesis 5: Two-way communication is vital for improving library website quality.

Methodology

During last few years, many of the library researches, concentrated on the web-based applications and their potentiality to enhance library services. Consequently libraries started creating an environment which allows users to avail library facilities wherever they spend time online. In their two distinct studies on the application of web 2.0 tools on library and government websites, Chua et al.[3,19] accommodated various web 2.0 features into the web-based library framework depending on their area of applications. Though earlier researches stressed on various components of library website quality, Chua and Goh[3] neatly distilled out three distinct components of website quality–system quality, information quality and service quality- focusing basically on the usability criteria of the library websites. According to them, system quality measures the functionality of websites; information quality assesses the value of the information provided to users; and service quality measures user's expectations against actual library services.

In the present study, content analysis method was used for data collection. Data were collected along the checkpoints on a checklists devised after consulting relevant literatures followed by discussion with experts in the field. Altogether six checklists were devised. Five checklists (Tables 1 to 5) represent five components of interactivity and the sixth checklist (Table 6) measures website quality. Each of the five interactivity checklists has five checkpoints and each checkpoint in a checklist has five options corroborating five point Likert-scale (5=strongly agree to 1=strongly disagree). The score along the checklist indicates the extent to which a coder agreed to the predominance of the facts represented by the checkpoints. However, website quality checklist has altogether fifteen checkpoints (Table 6) fitted to five point Likert-scale as well.

Table 1—Checklist for playfulness

	Playfulness	5	4	3	2	1
1	Library catalogue search functions can be embedded in personalized start page.					
2	Online library tour provides an interesting way to gain acquaintance with the library.					
3	Library resources can be accessible through browser plugin.					
4	Library website allows users to access, store and share data through mobile applications.					
5	Library offers individualized interface.					

Note: 5-Strongly agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly disagree

Table 2—Checklist for choice

	Choice	5	4	3	2	1
1	Responsiveness of the website is not browser specific.					
2	Colour, font size and layout design of the website is impressive.					
3	Website has printer-friendly page layout.					
4	Website has different types of navigational tools to make hopping section to section easier, e.g., horizontal text, vertical text, drop-down menus, icons & graphics, etc.					
5	Website provides customized service.					

Note: 5-Strongly agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly disagree

Table 3—Checklist for connectedness					
Connectedness	5	4	3	2	1
1 Library website is prominently linked to the institutional home page.					
2 Library is connected to various social networking sites (Facebook, Twitter, LikedIn, Google+, etc.) from where users can easily access to library resources and services.					
3 Users can contribute to library resources through blog, Flickr, Picasa, Pinterest, wiki, etc.					
4 Users can freely tag and organise library resources.					
5 Annotations provide useful objective and evaluative description of resources and instruction for access.					

Note: 5-Strongly agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly disagree

Table 4—Checklist for information collection					
Information collection	5	4	3	2	1
1 Users are regularly notified about the new additions to the library collections and facilities.					
2 Users can collect references using bibliographic management software like Zotero, EndNote, RefWorks, etc.					
3 Library has both podcasting and vodcasting facilities for the distant learners.					
4 Class lectures are readily made available to the prospective students through web applications.					
5 Access to learning materials through online course management tools like Blackboard, Moodle, Desire 2 Learn, etc.					

Note: 5-Strongly agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly disagree

Table 5—Checklist for reciprocal communication					
Reciprocal communication	5	4	3	2	1
1 Library has multidimensional online contact mechanism.					
2 Instant message box is directly linked through library home page.					
3 Chat widget can be easily accessible from non-library page.					
4 Online synchronous communication facility remains available for a long period.					
5 Query sent through email is fairly acknowledged and responded.					

Note: 5-Strongly agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly disagree

Table 6—Checklist for website quality					
System quality	5	4	3	2	1
1 The labels to access points are highly relevant.					
2 Speed of accessing desired resources and services is satisfactory.					
3 Search function associated with website can easily locate desired information.					
4 Resource organization supports both resource integration and user orientation.					
5 ID/password protected to prevent malicious leakage of personal information.					
Information quality	5	4	3	2	1
6 The contents are authentic and mostly error free.					
7 The information is consistently represented in the website.					
8 The contents are un-ambiguous and easily understandable.					
9 Information can be easily accessible.					
10 Users' contribution to library website are regularly monitored and edited.					
Service quality	5	4	3	2	1
11 Library's responsiveness to users' query is prompt.					
12 Guide to user regarding the use and installation of several online tools and applications are very effective.					
13 Resource discovery tool is very useful for conducting research.					
14 Multilingual facility is predominantly attached to various applications for the international students.					
15 Distinct mechanism for smooth and effective access to library resources from off-campus.					

Note: 5-Strongly agree; 4-Agree; 3-Neutral; 2-Disagree; 1-Strongly disagree

Data were collected along the website quality checklist, as deduced from the website quality framework, devised by Chua and Goh[3] and a bit modified by the researcher. Library website quality was measured by using the application index[20] (website quality). It is evident from calculation that a library with all checkpoints on website quality scoring 5 each (i.e. strongly agree), will have 100% application index (website quality). Therefore, higher the application index, better will be the quality of the website.

Application Index (website quality) =

$$\frac{\text{Total points calculated along the quality checklist}}{\text{Total number of checkpoints used} \times 5} \times 100$$

To distinguish between the high quality and low quality website, 50% score on application index (website quality) has been considered as cut-off value. Only the libraries having application index (website quality) 50% or above are considered as having high quality websites and are coded as 1, while those having less than 50% score are coded as 0. Thus the quality of library website was assessed by the presence or absence of codes 1 and 0. Website interactivity dimensions were measured by summing up the scores on each of the interactivity component checklist.

To determine the relationship between five interactivity dimensions (identified as five independent variables) and the website quality (dependent variable), binomial logistic regression analysis was employed. Binomial logistic regression is used to predict the presence or absence of an outcome on the basis of values of a set of predictor variables.

Sampling technique

Convenience sampling method was used to select elements of population from the sampling frame on the basis of ease of access. As there are a large number of libraries falling in the universe of population and no single directory comprehensively include each and every element of the population, elements of population were selected from the constructed sampling frame in an unstructured way. Three samples, representing three populations of continents, were drawn a) North America (80 libraries), b) Europe (40 libraries), c) and Australia (30 libraries).

Sampling frame

In order to minimize systematic bias that might have crept in due to adoption of non-random sampling technique, the researcher ensured that samples were drawn from appropriate sampling frame, accommodating libraries with diverse socio-economic conditions. Following online databases were consulted for accessing academic library websites: Academic Ranking of World Universities *(2010) (http://www.arwu.org/ARWU 2010.jsp);* Times Higher Education: the world university ranking *(http://www.timeshighereducation.co.uk/ world-university-rankings/)(2011)*; 4 International Colleges & Universities *(http://www.4icu.org/);* US Universities*(http://www.utexas.edu/world/univ/alpha/)*

Test of reliability

The reliability of the measuring instrument was tested by engaging four research scholars of library science who have knowledge on web-based library services. After being initially trained on the data collection procedure along the checklists, the researchers were asked to carry out survey independently on 10 library websites selected from the sampling frame. After they have coded along the six checklists independently, all four observations were compared. As multiple coders were used for the preliminary study, inter-rater reliability was tested using Cohen's Kappa and the pair-wise inter-coder reliability for all six checklists were found to fall within 0.62 to 0.76, indicating good non-random agreement in observation among the raters. Finally, wherever the difference in observation was noticed, the website was freshly accessed and analyzed and discrepancies were corrected. Thus the raters were made acquainted with the coding procedure and left to study rest of the 140 websites equally divided among them.

The limitations of the present study are as follows:

1. The study is based on some academic libraries limited to three continents only
2. Non-English websites were kept outside the purview of research
3. The dimensions for interactive features was quantitatively assessed and was not weighted against the frequencies of their occurrences

Analysis

One way ANOVA test (Table 7) was conducted and the result indicates that there is no significant difference in interactivity dimensions among academic libraries in three continents.

A correlation analysis (Table 8) shows that interactivity dimensions are correlated with the website quality. As correlation matrix is limited to

Table 7—ANOVA of library websites in three continents along the five dimensions

	Continents	N	Mean	StDev	MeanSq	F	Significance
Playfulness	North America	80	0.62	0.84			
	Europe	40	0.45	0.71	0.48	0.79	0.44
	Australia	30`	0.43	0.69			
Choice	North America	80	1.08	0.92			
	Europe	40	0.95	0.85	0.21	0.24	0.91
	Australia	30	0.88	1.06			
Connectedness	North America	80	1.04	1.04			
	Europe	40	0.91	1.09	0.83	0.75	0.41
	Australia	30	0.84	0.99			
Information collection	North America	80	0.85	0.64			
	Europe	40	0.66	0.83	1.34	2.11	0.09
	Australia	30	0.73	0.97			
Reciprocal communication	North America	80	1.06	0.95			
	Europe	40	0.87	0.86	1.05	1.37	0.19
	Australia	30	0.94	0.76			

Table 8—Correlation analysis among the interactive dimensions

	Quality	Playfulness	Choice	Connectedness	Information collection	Reciprocal communication
Quality	1.00					
Playfulness	0.28	1.00				
Choice	0.19	0.23	1,00			
Connectedness	0.41	0.25	0.17	1.00		
Information collection	0.18	0.12	0.21	0.20	1.00	
Reciprocal communication	0.37	0.27	0.18	0.36	0.32	1.00

show collinearity among two variables only, a series of multiple regression analysis was conducted to assess multicollinearity among independent variables.

Accordingly, a series of five different multiple regression analyses were introduced, each time with an independent variable treated as dependent variable. Dependent variable in a regression equation with *coefficient of multiple determinations* exceeding 50% (i.e., $R^2 > 0.5$), is excluded from further logistic regression. The *Variance Inflation Factor* (VIF) of each of the multiple regression analysis was computed but none of the analysis shows very high value. It signifies interactivity dimensions do not have any area of significant overlapping effect.

Finally, binomial logistic regression analysis was conducted to determine the effect of interactivity dimensions on website quality. The binomial logistic regression is employed in a situation where the dependent variable is dichotomous (whether a library website is coded as 1 i.e., application index is 50% or

more) and the independent variables/covariates are continuous or categorical[21]. The binomial logistic regression model can be represented as:

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 \ldots.. + \beta_n x_n$$

x_1, x_2…,x_n are the number of independent variables; β is the logistic regression coefficients ; y is the logit or log odds of the dependent variable; α is the constant.

The stepwise binomial logistic regression analysis is shown in Table 9. The Wald statistic reveals that four covariates–playfulness, connectedness, information collection and reciprocal communication-are all significant at 0.05 level and are retained, as shown in *variable in equation*. Result from the Score test for the covariate choice reveals that the Score statistic is non-significant and therefore choice is eliminated, as illustrated in *variable not in equation*. Moreover, Likelihood ratio test conducted on four retained covariates confirmed that they all are significant.

Table 9—Binomial logistic regression

Variables in equation						
Covariates	β	StErr	Wald	df	*P*	*Exp(*β*)*
Playfulness	0.57	0.21	7.367	1	0.002	1.310
Connectedness	0.71	0.32	4.922	1	0.003	4.691
Information collection	0.66	0.28	5.556	1	0.002	3.225
Reciprocal communication	0.78	0.26	9.131	1	0.000	5.432
Constant	-5.06	0.64	58.016	1		

Variable not in equation

Covariates	Score	df	*P*	*Exp(*β*)*
Choice	1.58	1	0.23	0.00

Model summary

	-2 Log likelihood	Cox and Snell R^2	Nagelkerke R^2
Score	97.413	126.66	0.35

Homer–Lemeshow test is commonly used to measure the overall goodness of fit of a binary logistic regression model. The $\chi 2$ value of Hosmer–Lemeshow test is 5.21 at 8 degrees of freedom with $P = 0.753$ indicating that model prediction is not significantly different from observed values, implying the model adequately fits the data. Nagelkerke R^2 statistic is used to measure the usefulness of the independent variables in predicting the dependent variable. The calculated value of Nagelkerke R^2 (0.35) testifies the model as a useful one in predicting library website quality.

Therefore the relationship of four interactivity dimensions – playfulness, connectedness, information collection and reciprocal communication – with website quality may be deduced from Table 9 and represented by the following equation; cited as online interactivity model:

$y = -5.06 + (0.57 \times v_1) + (0.71 \times v_2) + (0.66 \times v_3) + (0.78 \times v_4)$

Where y = natural log of odds of website quality; v_1 = playfulness; v_2 = connectedness; v_3 = information collection and v_4 = reciprocal communication

The above online interactivity model justifies null hypotheses 1, 3, 4 and 5 predicting the effect of interactivity dimensions - playfulness, connectedness, information collection and reciprocal communication - on website quality. However, the model rejects null hypothesis 2, as the covariate choice failed to exert any significant influence on website quality. The model also suggests that reciprocal communication ($\beta = 0.78$) is the strongest predictor of website quality, followed by connectedness ($\beta = 0.71$), information collection ($\beta = 0.66$) and playfulness ($\beta = 0.57$); however, covariate choice is insignificant.

Discussion

Reciprocal communication as studied by Chen and Yen[15] in e-commerce website, has also been proved highly significant in determining the library website quality. Here the exchange of information should closely relate to a sequential order[22,9]. Reciprocal communication ensures librarian-user interaction, the prime criteria for interactive website, and encouraging users' participation in library service. For example, instant messaging serves as useful communication tool for students to feel a stronger sense of community, find more venues for informal and social communication about not only class material, but also other valuable information[23]. Instant messaging, a popular communication medium among the teenagers[24] is being widely used in libraries to provide text or chat based reference service guiding library users on various library facilities[25]. Besides this, email and feedback form submission too are highly effective to get in touch with the library. Therefore reciprocal communication is most influential factor in determining library website quality. Libraries having multiple ways of lively contact mechanism with its patrons, will attract more users to effectively harness the library services and facilities.

Connectedness is also a very significant predictor of website quality. Connectedness is increased with the users' attractions to the website where they are free to contribute and make social tagging of resources with like minded users describing library resources more flexibly, dynamically and openly[26]. Connectedness rests on the concept of library as a community service platform, where users interact with the website not as individual but as a flock (e.g., Library's link with Facebook, Twitter, Blog, Flickr, Picasa, YouTube, etc.), not only to access resources but also create contents, organise those and

share among themselves. Connectedness will be improved if the website is built to meet the needs of different groups of users. Thus connectedness becomes one of the most influential predictors of website quality.

Information collection is also a factor for exercising sizeable variation in dependent variable. As library is a service organisation and its services are primarily information intensive, information collection mechanism holds a strong position in determining the interactive nature of library website. Podcast and vodcast serve as conduits of information dissemination for the distant learners. Citation linkers and course management tools are being increasingly used by the academic communities. Class lectures are readily being made available online to the prospective users. Updates ranging from news and announcement, new additions in library collections to personalized lending status are automatically notified through RSS feeds. Therefore, this dimension has also to be considered while designing library website.

Unlike business website, playfulness in library website is a bit less significant among the four variables for predicting the dependent variable because majority of playfulness features were not entertained in library website where online games and software downloads were usually excluded from educational sites, however, "playfulness plays an important role in enhancing user attitude and behavioural intention to use the site"[27]. Playfulness in library website is visible when users are exposed to interactive features of the websites which allows them to experiment with tools and applications. Users add library catalogue, database search box, and other code snippets into their iGoogle or Netvibes page and access resources directly from their personalized start page. However, library's web presence through online game, *Second Life* allowing user to create *Avatar* and interact, is scarcely noticed among academic libraries. Libraries also allow users to scan QR Codes and access data from their mobile applications which relieve them from doing paper works. Playfulness enhances the use of library widgets e.g., browser search plugin, Google Docs, proxy bookmarklet, Libx toolbar, etc. to make searching faster and library research a bit easier.

Choice is not a significant exploratory variable in determining the improved quality of the library website. Choice is a relative that varies with the type of user group having varying degree of preference

level. Probably, it requires more technical intervention on the part of the web designers to make choice as significant preferred factor for the users for accessing to a website.

Conclusion

Interactivity dimensions for library websites have been empirically tested and four out of five dimensions used by Ha and James[14] have been retained. The study examined the way interactivity dimensions affects quality of academic library website. The study suggests that the four interactivity dimensions-reciprocal communication, connectedness, information collection, and playfulness have considerable impact on the quality of library website. However, choice does not have any significant effect on the library website quality. The online interactivity model, deduced from the binomial logistic regression analysis, following survey of 150 academic libraries from among three continents, will help librarians to determine the relationship of four independent variables (dimensions of interactivity) with the dependent variable (website quality). The model will also help assess the effect of each of the interactivity dimensions on the overall library website quality. Librarians can also measure the odds of website quality through quantifying interactivity dimensions using the model framed.

Checklists with checkpoints cited here will guide future researchers in formulating questionnaire/ schedule for conducting future research, extending the scope of present study into a deeper level of examining the impact of interactivity on the users' attitude and perception. It will help determine how the cognitive behavior of users is influenced with increased online interactivity and thereby motivate them towards improved harnessing of library facilities and services. The study will also help researchers, librarians and web developers alike to measure qualitatively the effect of interactivity dimensions on library website quality which will guide them in developing an interactive library website to attract users towards the library in order to – a) engage them in organising library resources, b) encourage their participation to continually changing library services in tune with the changing users' requirements, c) form online users' community to share information, harness library collection and services to the fullest extent, and d) promote library facilities while experiencing high quality online flavour. Further study may emphasise on the degree of occurrence of each

dimension and its relative impact on interactivity which exert strong influence on perceived website design quality.

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