

## A survey of user perceptions of digital library e-quality and affinity

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### ABSTRACT

Following the updated Information Systems (IS) success model, this study examines users' perceptions of digital libraries in terms of information quality (semantic success), system quality (technical success), service quality (application success) and affinity (effectiveness success), which the authors think provides a new view for digital library research and practice alike. In this study, the term e-quality is used to refer to information quality, system quality and service quality. Affinity with digital libraries is defined as the degree of importance that users place on digital libraries. Data collected from 357 digital library users are used for data analysis. The statistical method of comparing means is employed to explore the effect of individual differences on e-quality and affinity. Meanwhile, hierarchical regression analysis is employed to present the effect of e-quality on affinity. It is found that service quality is the most important determinant to predict the formation of affinity. The findings and their implications are discussed.

### Keywords

Digital libraries; Service quality; Information quality; System quality; Affinity; China

### 1. Introduction

A library is an important entity in each university. As the logical extension of physical libraries, digital libraries deliver information collection and associated services to user communities by using various information and communication technologies (ICT) in a modern information society (Heradio et al., 2012). Digital libraries in universities have achieved big progress given more than 50 per cent of the budget was committed by many academic libraries to purchase electronic resources (Noh, 2012). In this situation, library users can quickly and easily access more electronic resources than ever before (West & Miller, 2011). In China, digital libraries have achieved quick development since the Ministry of Education (MOE) initiated China Academic Library and Information System (CALIS) in 1998. CALIS provides the ultimate support for information users through its four national information centers: Science, Social Science and Humanities Information Center; Agricultural Information Center; Medical Information Center; and Engineering and Technology Information Center (Zhu, 2003). Academic libraries and social information service institutions in China could apply for joining CALIS, thus benefiting from various services provided by CALIS like interlibrary loan and document delivery, dissertation database building, online cataloguing and consortia acquisitions of imported resources

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(Luo, Wang, & Zhou, 2010).

Digital libraries face competition as information providers today (Ross & Sennyey, 2008). For a digital library, we suggest quality appears to be salient on its road towards success given quality represents “a degree of excellence” (Babalhavaeji et al., 2010, p. 594). Indeed, “greater attention is being paid to the quality evaluation of this type of information system” and a large number of digital library users are increasing their expectations and demands for better functionality and service (Heradio et al., 2012). DeLone and McLean presented the Information Systems (IS) success model in 1992. In this model, six dimensions of success were proposed, namely: systems quality (technical success), information quality (semantic success), use, user satisfaction, individual impacts and organizational impacts (effectiveness success). These six dimensions of success were suggested to be interrelated rather than independent given both process and causal considerations (DeLone & McLean, 1992). Ten years later, they updated this model by proposing some refinements. Specifically, service quality is added to system quality and information quality as components of IS success. Meanwhile, they use “net benefits” to replace the original terms “individual impacts” and “organizational impacts” (DeLone & McLean, 2003). In this study, the term e-quality is used to refer to information quality, system quality and service quality.

The utility of the above updated model for measuring IS success was discussed by DeLone and McLean (2003). Following them, some scholars have developed and tested portions of the model (e.g., Balaban, Mub, & Divjak, 2013; Wang, 2008; Wang & Liao, 2008; Wu & Wang, 2006). In this study, we examine affinity with digital libraries which is defined as the degree of importance that users place on digital libraries (Perse, 1986; Ruiz-Mafe & Sanz-Blas, 2006). Digital libraries are increasingly ignored and bypassed by their users who are no longer captive and tend to use other online information sources to satisfy their information needs (Ross & Sennyey, 2008). Consequently, it is difficult to build and retain the loyalty of library users, thus posing new challenges for digital library practice (Kiran & Diljit, 2012). In this situation, we suggest affinity with digital libraries can precisely present the exact nature of users’ both cognitive and affective dependence on digital libraries, thus reflecting the impact of digital libraries on individuals’ information life. So, in addition to the components of IS effectiveness success as suggested by DeLone and McLean (2003) which is oriented to IS in general, we suggest affinity with digital libraries should be examined and it can potentially become one of the most accurate descriptors of the effectiveness success variable in the context of digital libraries.

Digital libraries were much studied in prior literature. Kani-Zabihi, Ghinea and Chen (2006) discuss the essential meaning of digital libraries. They suggest a digital library is a collection of information objects and services that can be accessed and available digitally, having changed the way individuals interact with information. Zhou (2005) examines the development of digital libraries and the shaping of digital librarians in China. Goncalves et al. (2007) elaborate on the meaning of quality in digital libraries by proposing a model, examining quality issues with the information life cycle which has four major phases: information creation, distribution, seeking, and utilization. In this study, bearing in mind that quality is a subjective feeling by users whose point of view is crucial (Yaari, Baruchson-Arbib, & Bar-Ilan, 2011), we conduct a survey of users’ perceptions of digital libraries to explore whether individual differences impact e-quality and affinity as well as how e-quality impacts the formation of affinity, which we think provides a new view for digital library research and practice alike. Following this introduction, we review the

research background. Then, we describe the research methodology and data collection. Finally, we present the results of the research and the discussion and implications.

## 2. Research background

### 2.1. IS success model

Fig. 1 is the updated IS success model proposed by DeLone and McLean (2003). This updated model was based on the original IS success model proposed by the same authors 10 years ago in a separate paper (DeLone & McLean, 1992). In this updated model, semantic success can be measured by information quality and technical success can be measured by system quality. Meanwhile, effectiveness success can be measured by intention to use/use, user satisfaction and net benefits (DeLone & McLean, 2003). However, DeLone and McLean didn't mention what kind of success can be measured by service quality which we suggest can potentially measure application success of IS. Meanwhile, in addition to the dimensions mentioned in the model, we suggest other dimensions such as affinity can be a useful extension of the current effectiveness success which describes the impact of IS on the user. Consequently, the updated IS success model provides sound theoretical support for this study.

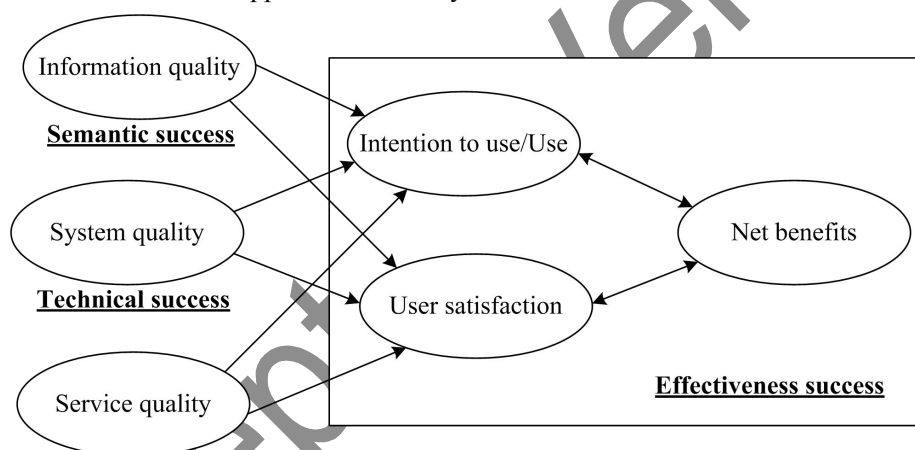


Fig. 1. Updated IS success model

Following DeLone and McLean (1992; 2003), some researches have developed and tested portions of this IS success model. Wang (2008) validates a model for assessing e-commerce systems success which consists of six constructs (dimensions), namely: information quality, system quality, service quality, perceived value, user satisfaction and intention to reuse. Wu and Wang (2006) propose and empirically assess a knowledge management system (KMS) success model which consists of five constructs, namely: system quality, knowledge or information quality, perceived KMS benefits, user satisfaction, and system use. Wang and Liao (2008) provide an empirical test of an adaptation of the IS success model in the context of eGovernment which consists of six constructs, namely: information quality, system quality, service quality, use, user satisfaction, and perceived net benefit. Similarly, Balaban, Mub and Divjak (2013) use these six constructs to develop an e-portfolio success model. To the best of our knowledge, prior research has never investigated digital libraries through the lens of IS success model.

### 2.2. Digital libraries and e-quality

Advanced ICT catalyze digital library research and practice (Zhang, 2010). As a type of information systems, digital libraries have gone “from a curiosity to mainstream” during the past 30 years (Arms, 2012, p. 579). A digital library is a distributed system that has the capability to store various electronic resources, which may be conveniently accessed by end users via network (Zhou, 2005). The unique characteristics of digital libraries include: information resources in various media; mass storage of information resources; distributed information resources management; networked information transmission; intelligent information retrieval technologies; high levels of information sharing; and information services without time and space limitations (Zhou, 2005). In China, CALIS has efficiently facilitated the construction of digital libraries in universities, with the aim of introducing and importing as well as creating various databases (Zhu, 2003). Consequently, a number of Chinese databases were introduced and a number of English abstract databases published by ISI and IEEE, as well as English full-text databases published by Elsevier, Emerald, Wiley, Sage, and Springer were imported, covering almost all the subjects and disciplines (Zha, Li, & Yan, 2012; Zhu, 2003). Given the lack of experience in purchasing foreign databases, cooperative purchase is provided by CALIS as one of the most popular and important services by which libraries can tie together to import and purchase foreign databases as consortia (Yao, 2012). Meanwhile, interlibrary loan (ILL) and document delivery (DD) services have obtained much attention given the insufficient funding of many small libraries. The CALIS ILL/DD services network was created in June 2004. It has about 60 large academic libraries which can provide lending service to other member libraries. So, users of small libraries could request remote and networked ILL/DD services through their home libraries (Yao & Zeng, 2012).

Even though quality is not easy to be defined precisely, there is a reached agreement that the quality of an activity should be evaluated in terms of its purpose (Babalhavaeji et al., 2010). The final purpose of digital libraries is to facilitate individuals to access human knowledge without time and space limitations in a friendly and easy way by using a variety of technologies (Heradio et al., 2012). What makes a good digital library different from a not so good one is the quality of its content and services (Goncalves et al., 2007) which needs to be judged by users themselves (Heradio et al., 2012).

The quality of digital libraries revolves around such aspects as information resources, equipment to facilitate the process of service delivery, environment in which information and services are provided, staff providing services, and attention paid to users' changing needs (Babalhavaeji et al., 2010). We suggest all these aspects can be well reflected by information quality, system quality and service quality as proposed in the updated IS success model (DeLone & McLean, 2003). Information quality refers to the quality of outputs which are produced by IS and can be in the form of online reports or online screens, concerning currency, accuracy and completeness (Gorla, Somers, & Wong, 2010). Whether certain information is good or not depends on personal perceptions and social environment and its quality judgment varies across individuals (Shah & Kitzie, 2012). System quality refers to the quality of IS processing per se, including software and data components. It can measure the extent to which IS are technically robust and sound (Gorla, Somers, & Wong, 2010).

A service is defined as “the work performed for someone else”, i.e., “it is an activity offered by others” (Chen & Chou, 2011, p. 238). In addition to system quality which measures technical success and information quality which measures semantic success (DeLone and McLean, 2003), we suggest service quality which is defined as the level of service delivered to users by digital

libraries in terms of reliability, responsiveness, empathy and assurance (Gorla, Somers, & Wong, 2010) is likely to be salient given the emergence of many new services provided by digital libraries. Library services normally and traditionally “involve interaction between the user and the librarian”. However, over the last two decades, “library services are shifting to the Web environment” (Chen & Chou, 2011, p. 238), and many new services are introduced. These modern library services include: access to digital collections such as electronic journals, online databases, e-books; personalized services; Web portals; online library instruction; online document delivery; electronic publishing; helpdesk services and online reference (Kiran & Diljit, 2012).

### *2.3. Affinity with digital libraries*

Affinity was conceptualized as “the perceived importance of the medium in the life of the individual” (Aldás-Manzano, Ruiz-Mafé, & Sanz-Blas, 2009, p. 740). Perse (1986) examines affinity to soap opera; Ruiz-Mafe and Sanz-Blas (2006) examine Internet affinity; Aldas-Manzano, Ruiz-Mafe and Sanz-Blas (2009) examine mobile affinity. In this study, affinity is conceptualized as the degree of importance that users place on digital libraries (Perse, 1986; Ruiz-Mafe, Sanz-Blas, 2006). Like the importance of air and water in people’s living life, we suggest digital libraries can potentially be of equal importance for people’s academic information life. However, students and researchers seem to favor other non-library online services even though academic libraries continually take efforts to adopt new technologies to improve services (Kiran & Diljit, 2012). In this situation, we suggest affinity with digital libraries can play the role as one of the most accurate variables to measure the effectiveness success of digital libraries.

## **3. Method and data collection**

We investigated four constructs (latent variables) in our study, namely: information quality of digital libraries, system quality of digital libraries, service quality of digital libraries, and affinity with digital libraries. All these constructs and the corresponding measure items were adapted from the previous literature with the consideration of the context of this study. Specifically, the items measuring system quality of digital libraries and information quality of digital libraries were adapted from Wixom and Todd (2005) and Zhou (2011); the items measuring service quality of digital libraries were adapted from Zhou (2011) and Zhou (2012); the items measuring affinity with digital libraries were adapted from Aldás-Manzano, Ruiz-Mafé and Sanz-Blas (2009).

After the instrument was developed, 20 graduate students were selected for our pilot survey. We thus had the opportunity to interact with some of these users. Based on their feedback, we adjusted the wording in several items. The complete instrument is presented in the Appendix. All items were measured with a 7-point disagree-agree Likert scale in which 1 represents strongly disagree while 7 represents strongly agree. Then, we conducted a large scale survey.

The large scale survey data collection lasted for five weeks through an online survey website which provides convenient functionality for designing questionnaire. In the survey questionnaire, we first described digital libraries and listed some Chinese databases such as China National Knowledge Infrastructure (CNKI), Wanfang Digital Periodicals and some English abstract databases such as SCI, SSCI, as well as some English full-text databases published by Elsevier, Emerald, Sage, Wiley and Springer. Library users of ten universities in China are the targeted population of this study. After publishing questionnaire online, we randomly invited library users of these universities through email or instant messaging to visit our online questionnaire where we

explain the purpose of this study and solicit their participation. Consequently, 357 valid responses were used for data analysis for this study after deleting the invalid responses (the responses in which 4 were chosen across all the items were deleted; according to the amount of time recorded by the online survey website for each respondent, the responses finished within short time were deleted). Table 1 documents the demographic information of these 357 respondents.

**Table 1**  
Demographic information of 357 respondents.

Category	Item	Frequency	Percent
Gender	Male	177	49.6
	Female	180	50.4
Age	18-25	251	70.3
	26-35	77	21.6
	>35	29	8.1
Position	Undergraduate	145	40.6
	Master student	116	32.5
	Doctoral student	44	12.3
	Faculty	52	14.6
Field	Natural Sciences	112	31.4
	Social Sciences	158	44.3
	Arts and Humanities	50	14.0
	Others	37	10.4
Your experience with digital libraries (year)	<1	60	16.8
	1-2	86	24.1
	2-3	59	16.5
	3-4	40	11.2
	>4	112	31.4

#### 4. Data analysis

This study investigates the following specific research questions: Do different user groups have different perceptions of digital libraries in terms of e-quality and affinity? What factors can predict the formation of affinity with digital libraries? How do information quality, system quality and service quality specifically impact affinity with digital libraries?

##### 4.1. Measurement model

The measurement validity was assessed in terms of content validity, convergent validity and discriminant validity (Straub, Boudreau, & Gefen, 2004). Regarding content validity, we believe all the constructs and items in this study each are clearly expressed with correct meaning given all of them are based on the previous literature.

Table 2 lists the value of CR (Composite Reliability), Cronbach's Alpha and AVE (Average Variance Extracted). Convergent validity was assessed with Cronbach's alpha and CR, and can be established with a score bigger than 0.7 (Straub, Boudreau, & Gefen, 2004). From Table 2, it can be seen that the smallest value of Cronbach's Alpha is 0.774 and the smallest value of CR is 0.865,

thus suggesting that all the constructs have higher convergent validity and reliability.

**Table 2**

CR, Cronbach's Alpha and AVE of measurement model.

Constructs	Items	AVE	CR	Cronbach's Alpha
Affinity with digital libraries (AFFDL)	3	0.787	0.917	0.865
Information quality of digital libraries (IQDL)	3	0.681	0.865	0.774
Service quality of digital libraries (SERQDL)	4	0.730	0.890	0.816
System quality of digital libraries (SYSQDL)	3	0.782	0.915	0.868

From Table 3, it can be seen that the square root of each construct's AVE is bigger than its correlations with other constructs, suggesting all the constructs have higher discriminant validity (Straub, Boudreau, & Gefen, 2004).

**Table 3**

Correlations between constructs.

	AFFDL	IQDL	SERQDL	SYSQDL
AFFDL	<b>0.887</b>			
IQDL	0.368	<b>0.825</b>		
SERQDL	0.449	0.635	<b>0.854</b>	
SYSQDL	0.281	0.692	0.678	<b>0.884</b>

**Notes:** Diagonal elements are the square root of each construct's AVE.

Given the validity of the measurement model, we thus believe it is appropriate to conduct data analysis so as to answer the specific research questions of this study. The score of the four constructs this study examines was each calculated based on their measurement models.

#### 4.2. Comparing means

In order to explore the influence of users' individual characteristics on their perceptions of digital libraries in terms of e-quality and affinity, we used the statistical method to compare means. Specifically, independent samples t test was used for two groups of independent samples and one-way Analysis of Variance (ANOVA) was used for more than two groups of independent samples.

Table 4 shows the result of independent samples t test grouped by gender. The results indicate no significant differences, suggesting that both male and female users of digital libraries perceive the same level of e-quality and affinity.

**Table 4**

Independent samples t test grouped by gender.

Construct	Gender	N	Mean	Standard Deviation	t	Sig. (2-tailed)
AFFDL	Male	177	4.216	1.479	-.617	.537
	Female	180	4.309	1.385		
IQDL	Male	177	4.806	1.220	-.674	.501

	Female	180	4.887	1.056		
SERQDL	Male	177	4.749	1.154	-1.678	.094
	Female	180	4.952	1.130		
SYSQDL	Male	177	5.135	1.235	-1.714	.087
	Female	180	5.343	1.050		

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

Table 5 shows the result of one-way ANOVA grouped by age. The results suggest that there are significant differences except for service quality of digital libraries (SERQDL) and system quality of digital libraries (SYSQDL). From Table 5, it can be seen that the mean of affinity with digital libraries for users with age being 26-35 is the biggest one, suggesting that this group of users are most likely to have the affinity with digital libraries. Meanwhile, the mean of information quality for users with age older than 35 is the biggest one, suggesting that this group of users are most likely to perceive the information quality of digital libraries.

**Table 5**  
One-way ANOVA grouped by age.

Construct	Age	N	Mean	Standard Deviation	F	Sig.
AFFDL	18-25	251	3.989	1.351	17.150	<b>.000***</b>
	26-35	77	4.973	1.485		
	>35	29	4.748	1.207		
IQDL	18-25	251	4.750	1.084	3.168	<b>.043*</b>
	26-35	77	5.062	1.262		
	>35	29	5.121	1.179		
SERQDL	18-25	251	4.784	1.122	1.635	.196
	26-35	77	5.049	1.208		
	>35	29	4.911	1.142		
SYSQDL	18-25	251	5.215	1.130	.300	.741
	26-35	77	5.330	1.243		
	>35	29	5.217	1.072		

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

Table 6 shows the result of one-way ANOVA grouped by current position. The results suggest that there are significant differences. From Table 6, it can be seen that the mean of IQDL and SYSQDL for faculty is the biggest one, suggesting that faculty is most likely to perceive the information and system quality of digital libraries. Meanwhile, the mean of AFFDL and SERQDL for doctoral student is the biggest one, suggesting that doctoral students are most likely to have high affinity with digital libraries and perceive high quality of the service provided by digital libraries.

**Table 6**  
One-way ANOVA grouped by current position.



Construct	Current position	N	Mean	Standard Deviation	F	Sig.
AFFDL	Undergraduate	145	3.635	1.295	28.017	<b>.000***</b>
	Master student	116	4.320	1.295		
	Doctoral student	44	5.468	1.300		
	Faculty	52	4.866	1.270		
IQDL	Undergraduate	145	4.693	1.067	5.130	<b>.002**</b>
	Master student	116	4.724	1.158		
	Doctoral student	44	5.195	1.114		
	Faculty	52	5.258	1.183		
SERQDL	Undergraduate	145	4.632	1.147	5.349	<b>.001**</b>
	Master student	116	4.820	1.146		
	Doctoral student	44	5.260	1.038		
	Faculty	52	5.187	1.080		
SYSQDL	Undergraduate	145	5.108	1.222	2.663	<b>.048*</b>
	Master student	116	5.177	1.112		
	Doctoral student	44	5.477	1.141		
	Faculty	52	5.549	0.948		

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

Table 7 shows the result of one-way ANOVA grouped by field. The results indicate that there are no significant differences among users who come from different fields, suggesting that users from different fields are likely to perceive the same level of e-quality and affinity.

**Table 7**  
One-way ANOVA grouped by field.

Construct	Current position	N	Mean	Standard Deviation	F	Sig.
AFFDL	Natural Sciences	112	4.070	1.492	1.218	.303
	Social Sciences	158	4.398	1.410		
	Arts and Humanities	50	4.204	1.404		
	Others	37	4.351	1.352		
IQDL	Natural Sciences	112	4.787	1.140	0.289	.833
	Social Sciences	158	4.873	1.107		
	Arts and Humanities	50	4.810	1.169		
	Others	37	4.968	1.262		
SERQDL	Natural Sciences	112	4.699	1.119	1.233	.298
	Social Sciences	158	4.969	1.146		
	Arts and Humanities	50	4.835	1.050		
	Others	37	4.832	1.319		
SYSQDL	Natural Sciences	112	5.177	1.087	0.888	.447
	Social Sciences	158	5.318	1.193		
	Arts and Humanities	50	5.056	1.100		
	Others	37	5.347	1.202		

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

Table 8 shows the result of one-way ANOVA grouped by experience with digital libraries. The results indicate that there are significant differences for all the constructs, suggesting experience with digital libraries plays an important role in users' perceptions of e-quality and affinity.

**Table 8**

One-way ANOVA grouped by experience with digital libraries.

Construct	Experience	N	Mean	Standard Deviation	F	Sig.
AFFDL	<1	60	3.419	1.520	17.544	<b>.000***</b>
	1-2	86	3.775	1.263		
	2-3	59	4.418	1.184		
	3-4	40	4.364	1.253		
	>4	112	4.972	1.320		
IQDL	<1	60	4.618	1.153	4.719	<b>.001**</b>
	1-2	86	4.704	1.129		
	2-3	59	4.634	1.012		
	3-4	40	4.764	1.286		
	>4	112	5.221	1.074		
SERQDL	<1	60	4.522	1.227	4.587	<b>.001**</b>
	1-2	86	4.717	1.228		
	2-3	59	4.748	1.059		
	3-4	40	4.786	0.964		
	>4	112	5.208	1.062		
SYSQDL	<1	60	4.982	1.254	2.886	<b>.022*</b>
	1-2	86	5.223	1.265		
	2-3	59	5.020	1.202		
	3-4	40	5.241	0.932		
	>4	112	5.508	0.988		

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

### 4.3. Predicting the formation of affinity with digital libraries

In the updated IS success model (see Fig. 1), information quality, system quality and service quality are each linked to user satisfaction which is used to measure effectiveness success of IS (DeLone & McLean, 2003). In this study, we suggest affinity with digital libraries can measure the effectiveness success of digital libraries more precisely. Following the IS success model, we thus examine the effect of information quality, system quality and service quality on affinity with digital libraries. Specifically, we employ hierarchical regression analysis to explore the formation of users' affinity with digital libraries. First, only demographic data are included as independent variables in Model 1. Second, system quality of digital libraries is added as independent variables in Model 2. Third, information quality of digital libraries is added as independent variables in

Model 3. Fourth, service quality of digital libraries is added as independent variables in Model 4. The results are shown in Table 9 below.

**Table 9**  
Hierarchical regression analysis.

Independent variables	Dependent variable			
	Affinity with digital libraries			
	Model 1	Model 2	Model 3	Model 4
Gender	-.021	-.033	-.023	-.032
Age	-.108	-.078	-.110	-.084
Position	<b>.293***</b>	<b>.257**</b>	<b>.265**</b>	<b>.231**</b>
Field	.064	.064	.053	.046
Experience with digital libraries	<b>.261***</b>	<b>.244***</b>	<b>.228***</b>	<b>.207**</b>
System quality of digital libraries		<b>.186***</b>	-.013	<b>-.182*</b>
Information quality of digital libraries			<b>.279***</b>	<b>.163*</b>
Service quality of digital libraries				<b>.380***</b>
<b>Model Summary</b>				
R <sup>2</sup>	.195	.228	.264	.332
Adjusted R <sup>2</sup>	.184	.215	.250	.317
<b>ANOVA</b>				
F	17.025	17.232	17.917	21.663
Sig.	.000	.000	.000	.000

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

From Model 1 of Table 9, it can be seen that position has a positive effect on affinity, i.e., with the position changing from undergraduate to postgraduate to doctoral student to faculty, the level of affinity as perceived gradually increases. Meanwhile, experience with digital libraries has a positive effect on affinity. It can be easily seen that the effects of position and experience with digital libraries exist across all the four models, illustrating the robustness of these effects.

From Model 2 of Table 9, it can be seen that system quality of digital libraries has a positive effect on affinity. From Model 3, it can be seen that information quality of digital libraries has a positive effect on affinity. Meanwhile, while including information quality of digital libraries, the effect of system quality of digital libraries disappears. This is consistent with the research by Wu and Wang (2006) who find that information quality has a big impact on user perceived benefits while system quality did not have. They suggest that system quality is necessary but not sufficient to provide benefits. In fact, users' perceptions of IS depend on the quality of outputs and contents produced by IS rather than the processing performance and functions of IS per se (Wu & Wang, 2006).

From Model 4 of Table 9, it can be seen that service quality has the biggest effect on affinity with the magnitude being 0.380. Meanwhile, the effect of system quality of digital libraries turns to negative, suggesting that the effect of service quality is so powerful that it can not only overpower the effect of system quality but also change the direction of its effect. So, in the context of digital libraries, the role of service quality is quite salient, which we suggest is consistent with the prior research whose results indicate that "service quality is an important factor in success"

(Landrum & Prybutok, 2004, p. 628).

## 5. Discussion and implications

It is well recognized that it is important to evaluate the quality of digital libraries from the user's perspective. However, the research which is based on users' perceptions is likely to be at an early stage (Heradio et al., 2012). In this study, we examine users' perceptions of digital libraries and present their points of view so as to fill this gap. Specifically, we collect data through a large scale survey oriented to users of university digital libraries. After validating the measurement model, we then use statistical method to explore the effect of individual differences on e-quality and affinity. Meanwhile, we use hierarchical regression analysis to present the effect of different factors on affinity. We believe the findings of this study have important implications.

The results in Table 4 indicate that for both male and female users, their perceptions regarding e-quality and affinity have no significant difference which we think is consistent with the prior research to some extent which suggests no statistically significant difference was found between genders in terms of frequency of library database use (Lim & Kwon, 2010). The results in Table 7 indicate that for users coming from different disciplines, their perceptions regarding e-quality and affinity have no significant difference which we think is concordant with the prior research to some extent which suggests no significant differences were found among disciplines regarding users' satisfaction with libraries' electronic collection (Gerke & Maness, 2010).

From Table 6, it can be seen that significant differences were found among positions regarding users' perceptions of e-quality and affinity. Specifically, doctoral students and faculty have higher levels of perceptions of digital libraries. From Table 8, it can be seen that significant differences were found among users who have different experience with digital libraries regarding e-quality and affinity. Meanwhile, from Table 9, we can see that experience with digital libraries has a significant effect on affinity across all the four models, suggesting the robustness of this effect. This means users with more experience with digital libraries are more likely to have affinity. In other words, users with less experience with digital libraries are less likely to have affinity. In this respect, simply making a digital library available cannot guarantee its success. This is a big challenge for librarians in university libraries since each year the experienced users would leave after graduation and newly registered users who lack experience with digital libraries would come. We thus recommend that user training is much needed for both new users who need to take the first step to use digital libraries and the users with relatively fewer years of experience with digital libraries who may probably abandon digital libraries on the way given "libraries are no longer islands of information, but one among many nodes through which information flows to the users" (Ross & Sennyey, 2008, p. 146).

Other factors were initially thought to be the drivers of success, but "service quality issues soon became pivotal" (Parasuraman, Zeithaml, & Malhotra, 2005, p. 213). In this study, we measure service quality in terms of reliability, responsiveness, empathy and assurance (Gorla, Somers, & Wong, 2010). Reliability reflects accuracy and dependability of the digital library service team (Gorla, 2011), i.e., the success probability of the service delivered by the digital library service team during a given period of time (Goncalves et al., 2007). Responsiveness reflects the digital library service team's willingness to provide prompt service. Empathy reflects individual and specific attention paid by the digital library service team to users (Gorla, 2011). Assurance reflects the knowledge and ability of the digital library service team to instill

confidence into users. Accordingly, for the construct service quality of digital libraries in this study, the four items of it each reflect these four aspects with four phrases, namely: dependable services, prompt services, personalized services, and professional services.

For personalized services, we already see good applications. At the University of Oklahoma library, “once users have created their personalized webpage, they see this information every time they log onto the university library system”. The premise of this personalized service is that users are likely to frequently visit a few of their favorite databases (Kim & Abbas, 2010, p. 212). For professional services, the manager of digital libraries should think more about whether their librarians have adequate knowledge and ability to provide professional service for the users. This is important given users are unlikely to believe that the librarian has the right and adequate knowledge to help solve their specific information need. Instead, users are likely to plan a series of information activities that they would rather undertake by themselves than delegate to the librarian (Pinto, Fernandez-Marcial, & Gomez-Camarero, 2010).

The direct and intermediate links between service quality and effectiveness success have not been well understood (Zeithaml, Berry, & Parasuraman, 1996). The result of this study (see Model 4 in Table 9) suggests that if users perceive a higher level of service quality, they would perceive a higher level of affinity even if they perceive a lower level of system quality. In other words, if users perceive a lower level of service quality, they would perceive a lower level of affinity even if they perceive a higher level of system quality. This means service quality can strongly overpower the effect of system quality and also is the most important determinant for the formation of affinity with digital libraries. We suggest the findings of this study usefully contribute to the research about the links between service quality and effectiveness success in the specific context of digital libraries and beyond more generally. We recommend that in the management practice of digital libraries, the four aspects of service quality should all be of the priority given it is the associated services delivered to user communities that make digital libraries unique. Indeed, “libraries function differently from business entities” (Kiran & Diljit, 2012, p. 184) and we suggest digital libraries could take advantage of their service quality to build and retain the loyalty of their users. Only in this way can the effectiveness success of digital libraries be achieved and the real meaning of digital library initiative be signified.

## **6. Conclusion**

The overall quality of digital libraries has been overlooked in prior literature even though the number of digital library projects keeps growing in the last decade (Zhang, 2010). This study conducted a survey of users’ perceptions of digital libraries from the perspective of e-quality and affinity in the hopes that the results can fill the gap. We find service quality is the most important determinant to predict users’ perceptions of affinity with digital libraries and we make recommendations for digital library management practice accordingly. Given the challenge that information seekers are likely to neglect source quality in favor of ease of use and convenience (Kim & Sin, 2011; Yan, Zha, & Xiao, 2013), we suggest that further qualitative study is needed to examine quality and success issue of digital libraries. We believe this further study would collect richer qualitative data to lead to more interesting findings which would usefully complement the findings presented here.

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## Appendix: Constructs and items

Constructs	Items
Information quality of digital libraries (adapted from Wixom & Todd, 2005; Zhou, 2011)	<ol style="list-style-type: none"> <li>1. The information in the digital library of my university is up to date.</li> <li>2. The information in the digital library of my university is accurate.</li> <li>3. The information in the digital library of my university is comprehensive.</li> </ol>
System quality of digital libraries (adapted from Wixom & Todd, 2005; Zhou, 2011)	<ol style="list-style-type: none"> <li>1. The digital library of my university is reliable.</li> <li>2. The navigation of the digital library of my university is effective.</li> <li>3. The layout of the digital library of my university is clear.</li> </ol>
Service quality of digital libraries (adapted from Zhou, 2011; Zhou, 2012)	<ol style="list-style-type: none"> <li>1. The digital library of my university provides dependable services.</li> <li>2. The digital library of my university provides prompt services.</li> <li>3. The digital library of my university provides personalized services.</li> <li>4. The digital library of my university provides professional services.</li> </ol>
Affinity with digital libraries (adapted from Aldás-Manzano, Ruiz-Mafé, & Sanz-Blas, 2009)	<ol style="list-style-type: none"> <li>1. Seeking information in the digital library of my university is one of my main daily activities.</li> <li>2. The digital library of my university is important in my life.</li> <li>3. I cannot go for several days without seeking information in the digital library of my university.</li> </ol>

## References

- Aldás-Manzano, J., Ruiz-Mafé, C., & Sanz-Blas, S. (2009). Exploring individual personality factors as drivers of M-shopping acceptance. *Industrial Management & Data Systems*, 109 (6), 739–757.
- Arms, W.Y. (2012). The 1990s: the formative years of digital libraries. *Library Hi Tech*, 30 (4), 579–591.
- Babalhavaeji, F., Isfandyari-Moghaddam, A., Aqili, S.V., & Shakooii, A. (2010). Quality assessment of academic libraries' performance with a special reference to information technology-based services: Suggesting an evaluation checklist. *The Electronic Library*, 28 (4): 592–621.
- Balaban, I., Mub, E., & Divjak, B. (2013). Development of an electronic portfolio system success model: An information systems approach. *Computers & Education*, 60 (1), 396–411.
- Chen, Y.T., & Chou, T.Y. (2011). Applying GRA and QFD to improve library service quality.

- Journal of Academic Librarianship*, 37 (3): 237–245.
- DeLone, W.H., & McLean, E.R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research*, 3 (1), 60–95.
- DeLone, W.H., & McLean, E.R. (2003). The DeLone and McLean model of information systems success: a ten-year update. *Journal of Management Information Systems*, 19 (4), 9–30.
- Gerke, J., & Maness, J.M. (2010). The physical and the virtual: the relationship between library as place and electronic collections. *College & Research Libraries*, 71(1), 20–31.
- Goncalves, M.A., Moreira, B.L., Fox, E.A., & Watson, L.T. (2007). What is a good digital library? A quality model for digital libraries. *Information Processing and Management*, 43 (5): 1416–1437.
- Gorla, N. (2011). An assessment of information systems service quality using SERVQUAL+. *The DATA BASE for Advances in Information Systems*, 42 (3), 46–70.
- Gorla, N., Somers, T.M., & Wong, B. (2010). Organizational impact of system quality, information quality, and service quality. *Journal of Strategic Information Systems*, 19 (3), 207–228.
- Heradio, R., Fernandez-Amoros, D., Cabrerizo, F.J., & Herrera-Viedma, E. (2012). A review of quality evaluation of digital libraries based on users' perceptions. *Journal of Information Science*, 38 (3): 269–283.
- Kani-Zabihi, E., Ghinea, G., & Chen, S.Y. (2006). Digital libraries: what do users want? *Online Information Review*, 30 (4): 395–412.
- Kim, K.S., & Sin, S.C.J. (2011). Selecting quality sources: Bridging the gap between the perception and use of information sources. *Journal of Information Science*, 37 (2), 178–188.
- Kim, Y.M., & Abbas, J. (2010). Adoption of Library 2.0 functionalities by academic libraries and users: a knowledge management perspective. *The Journal of Academic Librarianship*, 36 (3), 211–218.
- Kiran, K. & Diljit S. (2012). Modeling Web-based library service quality. *Library & Information Science Research*, 34 (3), 184–196.
- Landrum, H., & Prybutok, V.R. (2004). A service quality and success model for the information service industry. *European Journal of Operational Research*, 156 (3), 628–642.
- Lim, S., & Kwon, N. (2010). Gender differences in information behavior concerning Wikipedia, an unorthodox information source? *Library & Information Science Research*, 32 (3), 212–220.
- Luo, C.R., Wang, J.F., & Zhou, Z.N. (2010). Regional consortia for e-resources: a case study of deals in the South China Region. *Program: electronic library and information systems*, 44 (4), 328–341.
- Parasuraman, A., Zeithaml, V.A., & Malhotra, A. (2005). E-S-QUAL: A multiple-item scale for assessing electronic service quality. *Journal of Service Research*, 7 (3), 213–233.
- Pinto, M., Fernandez-Marcial, V., & Gomez-Camarero, C. (2010). The impact of information behavior in academic library service quality: A case study of the science and technology area in Spain. *Journal of Academic Librarianship*, 36 (1): 70–78.
- Ross, L., & Sennyey, P. (2008). The library is dead, long live the library! The practice of academic librarianship and the digital revolution. *Journal of Academic Librarianship*, 34 (2), 145–152.
- Shah, C., & Kitzie, V. (2012). Social Q & A and virtual reference-comparing apples and oranges with the help of experts and users. *Journal of the American Society for Information Science*

- and Technology*, 63 (10): 2020–2036.
- Straub, D.W., Boudreau, M.C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems*, 13 (1), 380–427.
- Wang, Y.S. (2008). Assessing e-commerce systems success: a respecification and validation of the DeLone and McLean model of IS success. *Information Systems Journal*, 18(5), 529–557.
- Wang, Y.S., & Liao, Y.W. (2008). Assessing eGovernment systems success: A validation of the DeLone and McLean model of information systems success. *Government Information Quarterly*, 25 (4), 717–733.
- West, W.L., & Miller, H.S. (2011). Electronic journals: Cataloging and management practices in academic libraries. *Serials Review*, 37(4), 267–274.
- Wixom, B.H., & Todd, P.A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research*, 16 (1), 85–102.
- Wu, J.H., & Wang, Y.M. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model. *Information & Management*, 43 (6), 728–739.
- Yaari, E., Baruchson-Arbib, S., & Bar-Ilan, J. (2011). Information quality assessment of community-generated content –A user study of Wikipedia. *Journal of Information Science*, 37(5), 487–498.
- Yan, Y.L., Zha, X.J., & Xiao, Z.L. (2013). Exploring users' perceptions of conventional and unconventional electronic resources. *Serials Review*, 39 (2), 105–113.
- Yao, X.X. (2012). Evaluation and promotion: The cooperative purchase experience of academic libraries in China. *Library Collections, Acquisitions, & Technical Services*, 36 (3-4), 97–106.
- Yao, X.X., & Zeng, L.J. (2012). CALIS: interlibrary loan and document delivery services in China. *Interlending & Document Supply*, 40 (2), 111–114.
- Zeithaml, V.A., Berry, L.L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, 60 (2), 31–46.
- Zha, X.J., Li, J., & Yan, Y.L. (2012). Understanding usage transfer from print resources to electronic resources: a survey of users of Chinese university libraries. *Serials Review*, 38 (2), 93–98.
- Zhang, Y. (2010). Developing a Holistic Model for Digital Library Evaluation. *Journal of the American Society for Information Science and Technology*, 61(1):88–110.
- Zhou, Q. (2005). The development of digital libraries in China and the shaping of digital librarians. *The Electronic Library*, 23 (4), 433–441.
- Zhou, T. (2011). Examining the critical success factors of mobile website adoption. *Online Information Review*, 35 (4), 636–652.
- Zhou, T. (2012). Understanding users' initial trust in mobile banking: An elaboration likelihood perspective. *Computers in Human Behavior*, 28 (4), 1518–1525.
- Zhu, Q. (2003). China academic library and information system: Current situation and future development. *The International Information & Library Review*, 35(2–4), 399–405.