

MEASURING THE SUCCESS OF E-LIBRARY IMPLEMENTATION: STUDENTS PERCEPTIONS AND USE

Darko Etinger, Ph.D.¹, Jusuf Šehanović, Ph.D.², Antonio Ribić, univ.bacc.oec.³

¹Juraj Dobrila University of Pula, Faculty of Economics and Tourism "Dr. Mijo Mirković",
Republic of Croatia, darko.etinge@unipu.hr

²Juraj Dobrila University of Pula, Faculty of Economics and Tourism "Dr. Mijo Mirković",
Republic of Croatia, jusuf.sehanovic@unipu.hr

³Juraj Dobrila University of Pula, Faculty of Economics and Tourism "Dr. Mijo Mirković",
Republic of Croatia, antonio.ribic@unipu.hr

Abstract

The study examined the success factors for adoption of e-library information system among students in Croatia, focused on undergraduate and graduate students of Information Science at the Faculty of Economics and Tourism "Dr. Mijo Mirković". Using the DeLone and McLean's information systems (IS) success model, a research model is developed. Data is collected through a survey among students and web traffic analysis of the e-library IS. The key constructs of interest in this study are e-library information quality, system quality, service quality, user satisfaction, perceived net benefits and usage. To assess the measurement and structural model, the PLS-SEM (Partial least squares – structural equation modeling) approach is used. Implications for e-library management at universities is provided.

JEL Classification: D83

Keywords: E-library, DeLone & McLean Model, Information Systems Success, perceptions, use

1. INTRODUCTION

Technology has driven changes in communication, information-seeking behaviors and practices at universities, decreasing traditional visiting of the university library. Frank et al. (2001, 92) note that as scholarly communication and infor-

mation-seeking gravitated toward online sources, customized Web portals, and desktop access, students became more dependent on remote computer access but at the same time more overwhelmed by information noise. As digital resources increased exponentially over the last decade, academic libraries have heavily invested in electronic books, research databases, as well as electronic journals, and made them accessible via their library Web portals (Chen; 2011, 1). Chen further notes that despite an overwhelming literature validating or extending the IS success models, there's a lack of studies examining the IS use patterns in research pertaining to library information systems. This research focuses on students' e-library perceptions and use, exploring the e-library success drivers in semester-long time frame.

The digital repository of University of Jurja Dobrila of Pula, Department of Economics and Tourism "Dr. Mijo Mirković" is located at <http://e-knjiznica.unipu.hr> and is based on EPrints software. The application itself is written in Perl relying on the MySQL database and Apache while XML files are the most used configuration. The e-library application is installed on a dedicated server with Ubuntu Linux OS. Database and storage works on the same server, but they can be easily relocated if needed. To make it more user friendly with no need for registration and administration of user accounts, the application is using LDAP to link to AAI@edu.hr system.

EPrints allows serving multiple separated repositories on one session, but this possibility has not been used since the current repository is planned to expand for the needs of the entire University. It is expected for the university library to contain all relevant titles that are needed for mastering the course program. These include lectures and exercises, textbooks, science books, journal articles, seminars, finals, master's theses and doctoral dissertations, projects, studies, reports, etc. The application itself contains a very elaborated categorization list (article, part of the book, monographs, conference materials, workshop materials, books, theses, patent, exhibition, performance, composition, design, image, video, audio, data set, experiment, class materials, etc.). The list can be edited according to the user needs. Also, the documents are assigned with element of the organizational structure and library classification. It is used by departments and divisions and valid UDC. The system advantage is the ability to index the entire contents of the documents, which results in higher quality and more detailed results than the conventional search by keywords. Google Analytics is used for usage monitoring since it is the simplest tool available to collect and analyze a large amount of useful information.

2. LITERATURE REVIEW

University libraries have invested a large amount of resources into digitizing information for the Web, yet scholars and practitioners question the value of this investment due to a lack of use of university library website resources (Kim; 2011, 63). Chen (2011, 1) states that there is a common concern among academic libraries that their library Web portals are being underutilized. DeLone & McLean (2003, 10) point that the measurement of information systems (IS) success or effectiveness is critical to our understanding of the value and efficacy of IS management actions and IS investments.

2.1. *Digital Library Evaluation Models*

Vullo (2010, 172) states that concepts and models for evaluating digital libraries come mainly from the research areas of library and information science (LIS) studies, computer science studies, and human-computer interaction (HCI) studies, adopting the following types of approach: 1. content-based approach (e-library as a collection of data and metadata), 2. technical-based approach (e-library as a software system), 3. service-based approach (e-library as an organization providing a set of intangible goods, i.e. benefits), 4. user-based approach (e-library as a personal and social environment). Kim (2011, 64) identified three perspectives of e-library usage: 1. user perspective (if library users perceive online resources as helpful, they are more likely to use the resources), 2. website design perspective (if a website design is simple, people are more likely to use it) and 3. library service quality perspective.

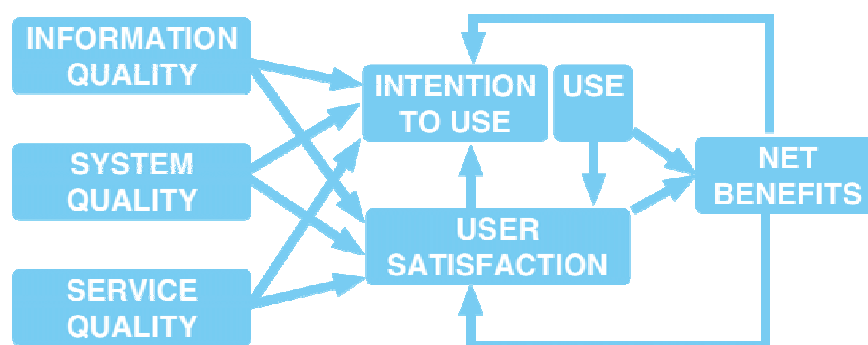
Schwartz (2000, 390) notes that evaluation might be concerned with usability, looking at the efficiency, effectiveness, and satisfaction with which users can achieve specified goals. Although measuring efficiency might be relatively straightforward, Schwartz (2000, 390) stressed there is little agreement as to how to measure effectiveness and satisfaction in library contexts. Chen (2011, 1) points that some libraries undertake usability initiatives to improve their Web portals in order to provide users with better and easier access to their electronic collections and services. Gonçalves et al. (2007, 1416) developed a quality model for digital libraries, while Xie (2008, 1346) argues there are many unanswered questions regarding e-library evaluation from users' perspectives.

2.2. Theoretical framework

There has been a considerable amount of research in the information science and technology field examining the determinants of IS success. Users's satisfaction has been widely adopted in information systems (IS) research as an indicator of IS success and use (e.g. DeLone & McLean; 2003, 23). According to DeLone and McLean model of IS success (2003, 23), information quality, system quality and service quality significantly affect both use and user satisfaction. Chen (2011, 1) points out that IS success models have been empirically tested and expanded in numerous studies (e.g., Wang, 2008; Häkkinen & Hilmola, 2008; Schaupp, Bélanger, & Fan, 2009).

The DeLone and McLean's (1992, 62) IS success model consists of six dimensions of IS success: system quality, information quality, use, user satisfaction, individual impact and organizational impact. This comprehensive and multidimensional model was updated in 2003 (DeLone & McLean; 2003, 23), with the advent of e-commerce. The authors added the "service quality" measure as a new dimension and grouped the "impact" measures into a single impact or category called "net benefits". As Vullo (2010, 172) points out, this model is considered relevant for building a global e-library evaluation framework. DeLone and Mclean (2003, 25) propose that a high-quality system will be associated with more use, more user satisfaction, and positive net benefits. Lwoga (2013, 4) states that system quality, service quality and information quality positively influence intention to use, actual system usage and user satisfaction while intention to use, actual use and user satisfaction influence net benefit (as shown on Figure 1.).

Figure 1. DeLone & McLean's updated IS Success Model



Source: DeLone & McLean; 2003, 24

The context of DeLone & McLean's IS success model variables applied to the e-library information system can be explained as:

1. Information Quality measures the output produced by the e-library,
2. System Quality measures the quality of the e-library IS,
3. Service Quality measures the critical aspect of the e-library service,
4. User Satisfaction measures the user's response to the use of the output of the e-library,
5. Intention to use measures users' attitude,
6. Net benefits integrated individual and organizational impacts e-library provides.

Chen (2011, 3) argues that the relationships between Use and User Satisfaction, as well as the correlation between Use and Net Benefits received moderate support from the IS literature. He concludes that although IS success model has been widely applied to research in the areas of e-commerce, knowledge management systems, and specialized business applications, library based studies grounded in this conceptual model are minimal. Tsakonas & Papatheodorou' findings (2008, 1234) demonstrate that several attributes of usefulness, such as the level and the relevance of information, and usability, such as easiness of use and learnability, as well as functionalities commonly met in these systems, affect user interaction and satisfaction.

3. METHODOLOGY

The present study seeks to find the success factors for adoption of e-library information system among students in Croatia, focused on undergraduate students of Information Science at the Faculty of Economics and Tourism "Dr. Mijo Mirković".

Based on the DeLone and McLean's IS success model, the following hypotheses are proposed:

- H1a.** Information quality positively affects Intentions to use e-library.
- H1b.** Information quality positively affects User satisfaction with e-library.
- H2a.** System quality positively affects Intentions to use e-library.
- H2b.** System quality positively affects User satisfaction with e-library
- H3a.** Service quality positively affects Intentions to use e-library.

H3b. Service quality positively affects User satisfaction with e-library

H4. User satisfaction positively affects Intentions to use e-library.

H5. User satisfaction positively affects e-library net benefits.

H6. Intentions to use positively affects e-library net benefits.

To test the proposed hypotheses, two tools are used: a) web traffic analysis of the e-library usage, b) an online questionnaire survey and using partial least squares structural equation modeling. The software tool WarpPLS 4.0 was used to assess the measurement and the structural model of our research. The survey questionnaires were composed of multiple choice questions (to collect demographic information) and Likert scales (to measure students' perceptions and use of the EPrints e-library information system). In the process of development of the survey, the constructs' indicators were applied from previous instruments based on the literature review. Each question was tailored to fit the context of this study. The survey items related to each of the constructs included in the model were measured using a five-point Likert scale. All items ranged from 1 (strongly disagree) to 5 (strongly agree).

4. RESULTS AND DISCUSSION

4.1. *Descriptive statistics*

A total of 236 valid surveys (out of 241 completed and 498 targeted) were collected from February 3rd to February 11th, 2014. Participation in the survey was voluntary and students were informed that there were no right or wrong answers, and their responses would be kept in confidence. Among the respondents, there were 132 male and 104 female undergraduate and graduate students, with the distribution as follows: 169 of 373 undergraduate 1st year, 35 of 53 undergraduate 2nd year, 23 of 37 undergraduate 3rd year, 4 of 10 graduate 1st year and 9 of 15 graduate 2nd year students. 16,52% students reported using the e-library IS frequently, 69,49% reported using it during the semester and only 13,98% used the e-library sporadically, rarely or never. Regarding the importance of the content students are most interested using the e-library for, 55.5% reported books and course books, 18,64% reported handbooks and seminars, 9,32% reported final and graduation theses and 16,54% reported scientific papers and experts reports.

4.2. *E-library system Usage*

For the traffic analysis of the first semester in the academic year 2013/14 we consider the time space between October 1st, 2013 and January 31st, 2014. Dur-

ing this time 21.041 unique visitors were logged making 28.817 visits. 77,95% (22.462 visits) originated from Croatia following Bosnia and Herzegovina with 12,04% (3.469 visits) and Serbia 4,63% (1.333 visits). About 0,47% (136 visits) is unknown with no information about country of origin. 108.782 pageviews were registered, with 46 seconds average time spent on page. Average visit duration is 2 minutes and 9 seconds. Registered bounce rate is 54,70% (15.764 visits), meaning that in those visits users did not interact with the page in any way. Because of such high percentage, bounce rate is an important factor to keep in mind during the analysis of all visit data, and especially average values. Average pages per visit rate is 3,77, but if we exclude bounced visits we receive a significantly different number. By deducting number of bounced visits from the total visit count we end up with 13.053 visits in given period, and similarly the pageview count must be diminished by the same number resulting in 93.018 pageviews, or 7,13 pageviews per visit.

Browsing the repository meta information is publicly available and it's indexed by the search engines, so it doesn't surprise that majority of all visits were originating from organic traffic sources like search engines. As expected, those visits are significantly shorter than other originating from referral traffic sources and are more likely to bring users who have adequate credentials to access full documents. By looking into a distribution of visits by numbers of visited pages during a single visit, 2,73% (786 visits) is accountable for 32,53% (35.386) pageviews during visits on which users explored twenty or more pages. Visits with only one pageview are considered bounced since users did not engage additionally with the page. Similarly, in the visits by visit duration distribution, it is visible that 58,85% (16.956) of all visits lasted up to 10 seconds. In the longest visit duration group, the one containing visits lasting longer than 1801 seconds, 295 visits were registered responsible for 17.293 pageviews. From the collected data it is obvious that number of pages per visit increases with visit duration.

At the present moment there are 2.086 records published in the repository. 52,25% (1.410 records) consists of theses and the rest are books, book parts, articles and other content. An important part to be considered while analyzing record views is the fact that most of the non-thesis records were added during the observed period of time while thesis records were earlier additions. Keeping this in mind it's not surprising that nine of ten most viewed records are thesis, and the remaining ones are books. Interestingly, one book is the most viewed record with 574 total and 363 unique pageviews. Along with being the most visited record it's the one with the shortest time on site, only 56 seconds. Knowing that this particular is

part of the obligatory literature for a class, leads to a conclusion that it is mostly visited by students who are acquiring (downloading) literature for their classes. As mentioned before, content of the faculty e-library is indexed by the search engines, and is displayed in their search results, so it doesn't surprise that the rest of most visited records consist of terms that are very trending in public. Average time spent viewing those records varies from 2 minutes and 7 seconds up to 4 minutes and 35 seconds, suggesting that visitors were indeed doing research and reviewing information displayed on that pages.

4.2. IS Success model assessment

The research model was assessed using a two-step approach. First, the measurement model was analysed following the structural model analysis. The factor structure matrix of item loadings and cross-loadings is shown in Table 1. The convergent validity of each construct is achieved as the item loadings for each construct are above the threshold of 0.708 (Hair et al.; 2014, 103). 5 items didn't meet the minimum requirements and were removed from the model.

Table 1: Factor structure matrix of loadings and cross-loadings

	INFOQUAL	SYSQUAL	SERVQUAL	USE	SAT	NETBEN
INFOQUAL1	0.720	0.434	0.581	0.400	0.587	0.536
INFOQUAL5	0.854	0.452	0.591	0.457	0.510	0.411
INFOQUAL6	0.855	0.386	0.548	0.474	0.519	0.490
SYSQUAL3	0.469	0.836	0.574	0.388	0.592	0.533
SYSQUAL4	0.494	0.847	0.576	0.386	0.527	0.431
SYSQUAL5	0.369	0.748	0.493	0.479	0.420	0.402
SYSQUAL6	0.343	0.802	0.498	0.484	0.452	0.415
SERVQUAL1	0.559	0.523	0.811	0.427	0.591	0.513
SERVQUAL2	0.585	0.639	0.819	0.422	0.625	0.548
SERVQUAL3	0.550	0.563	0.809	0.466	0.551	0.485
SERVQUAL4	0.585	0.406	0.796	0.439	0.614	0.560
SERVQUAL5	0.509	0.495	0.729	0.499	0.638	0.605
USE1	0.520	0.531	0.568	0.806	0.662	0.638
USE2	0.394	0.391	0.424	0.825	0.501	0.525
USE3	0.421	0.444	0.432	0.846	0.453	0.504
USE4	0.473	0.397	0.446	0.820	0.455	0.462
SAT1	0.567	0.524	0.686	0.552	0.899	0.634

SAT2	0.584	0.501	0.649	0.486	0.891	0.634
SAT3	0.549	0.571	0.651	0.606	0.845	0.667
SAT4	0.593	0.561	0.660	0.543	0.846	0.630
NETBEN1	0.466	0.412	0.573	0.521	0.628	0.808
NETBEN2	0.459	0.406	0.514	0.541	0.592	0.819
NETBEN3	0.537	0.472	0.574	0.541	0.550	0.793
NETBEN4	0.466	0.467	0.515	0.512	0.614	0.836
NETBEN5	0.430	0.469	0.576	0.487	0.584	0.777

Source: Author's calculations

Table 2. indicates Composite reliability, the Cronbach's Alpha coefficient, Average Variance Extracted (AVE) along with the square roots of the AVE (highlighted numbers in the diagonal) and the correlation between constructs. The verification of the reliability of indicators was obtained using Cronbach's alpha coefficient (Cronbach, 1970.), testing the contribution made by each indicator to be similar, as well as the composite reliability coefficient (Werts et al., 1974.) which takes respective indicators into account. Convergent validity, measured by Average Variance Extracted (AVE), represents the common variance between the indicators and their construct and should be higher than 0.5 (Hair et al.; 2014, 103). In order to confirm the discriminant validity among constructs (Fornell-Lacker criterion) the AVE square root must be superior to the correlation between constructs.

Table 2: Cronbach's alpha (CA), Composite Reliability (CR), Average Variance Extracted (AVE) and Discriminant Validity of the constructs

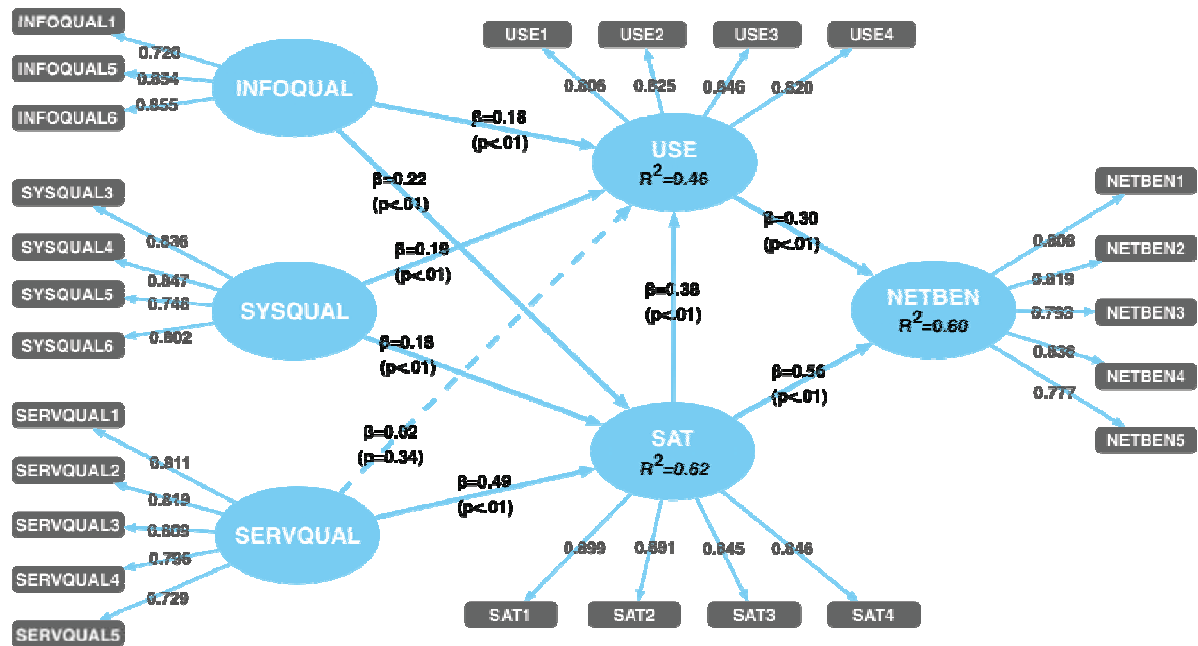
	CA	CR	AVE	(1)	(2)	(3)	(4)	(5)	(6)
INFOQUAL (1)	0.739	0.852	0.660	0.812					
SYSQUAL (2)	0.824	0.883	0.655	0.520	0.809				
SERVQUAL (3)	0.852	0.895	0.630	0.703	0.663	0.793			
USE (4)	0.842	0.894	0.679	0.548	0.534	0.566	0.824		
SAT (5)	0.893	0.926	0.758	0.658	0.618	0.759	0.627	0.871	
NETBEN (6)	0.866	0.903	0.651	0.584	0.551	0.681	0.645	0.736	0.807

Note: Square roots of AVEs shown on diagonal.

Source: Author's calculations

After establishing the reliability for the items and the convergent and discriminant validity of the constructs, we examined the structural model. The results of the PLS analysis for the hypotheses H1a to H6 are shown in Figure 2.

Figure 2: Structural model results



Source: Author's calculations

The model shows no collinearity problems, as the average block variance inflation factor VIF (AVIF)=2,272 (acceptable if ≤ 5) and the average full collinearity VIF (AFVIF)=2,556 (acceptable if ≤ 5). The average path coefficient (APC) is 0,278 ($p < 0,001$) while the average R-squared (ARS) is 0,561 ($p < 0,001$) and the average adjusted R-squared (AARS) is 0,555 ($p < 0,001$). The predictive capability of the model is thus satisfactory because all R-Squares are higher than 0,10 and they can be interpreted as moderate for Satisfaction ($R^2=0,62$), weak for Intentions to use ($R^2=0,46$) and moderate for Net benefits ($R^2=0,60$). Table 3. summarizes the relationships between constructs, namely the direct, indirect and the total effects of the variables.

Table 3: The direct, indirect and total effects of variables

	Direct effects			Indirect effects			Total effects		
	USE	SAT	NETBEN	USE	SAT	NETBEN	USE	SAT	NETBEN
INFOQUAL	0.177	0.218		0.083		0.174	0.260	0.218	0.198
SYSQUAL	0.187	0.176		0.067		0.153	0.254	0.176	0.173
SERVQUAL	0.022	0.486		0.186		0.277	0.208	0.486	0.332
USE			0.296						0.296
SAT	0.382		0.557			0.113	0.382		0.670

Source: Author's calculations

The structural model shows a significant positive relationship between all constructs except for the relationship between Service quality and Intentions to use. Therefore, hypotheses H1a, H1b, H2a, H2b, H3b, H4, H5 and H6 are all supported ($p < 0,01$). The hypothesis H3a is found positive but not significant, therefore it is rejected. These findings are mostly in compliance with the literature, except H3a needs further investigation.

By analysing the direct, indirect and total effects, it is evident Service quality affects Intentions to use indirectly through User satisfaction ($\beta = 0,186$, $p < 0,01$). Our interpretation is that User satisfaction mediates the relationship between Service quality and Intentions to use. The R-squared of the construct Intentions to use is very close to moderate, but still weak. Hence we conducted the web traffic analysis to further assess the e-library usage. With increased e-library usage, better insight into the usage patterns could be obtained. Still, our findings show User satisfaction with e-library system and the content it provides is the dominant driver for continuous e-library use. In compliance with DeLone & McLean (2003, 18), Service quality is the most important variable measuring the overall success of the e-library IS. Close attention to Information quality should be directed, as sufficient and useful content are important drivers of satisfaction and use, thus generating net benefits in the form of completed students' assignments and increased skills and capabilities. University decision-makers should create a formal framework for e-library content collection and relevancy assessment to include adequate content into the e-library repository. The e-library IS should be promoted as a comprehensive tool fitted to students' needs and tasks.

5. CONCLUSION

Based on DeLone & McLean IS succes model, this study examined the e-library usage through a web traffic analysis and success drivers via the partial least squares structural equation modeling. The role of quality (information quality, system quality and service quality) in affecting user satisfaction, intentions to use and net benefits was examined on undergraduate and graduate students of Information Science at the Faculty of Economics and Tourism “Dr. Mijo Mirković” in the e-library IS. The findings resonate with prior studies to a great extent, validating the DeLone & McLean’s IS success model in the context of e-library.

This work could help e-library management formulate strategies to promote use. It could help establish a quatitative evaluation program for continuous monitoring and evaluation to enable periodic enhancements. With a careful content collection framework, the e-library could be enriched bringing bigger benefits to the users. All of this could help define guidelines for future e-library upgrades, ensuring the quality of the content, the quality of the system, as well as the quality of the service.

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