

The Development of Digital Library User Interface by Using Responsive Web Design and User Experience

Dimas Sasongko^{*1}, Ridi Ferdiana², Rudy Hartanto³

^{1,2,3}Faculty of Engineering Gadjah Mada University, Jalan Grafika No. 2 Yogyakarta, +62-274-513665

¹Faculty of Electrical and Informatics Engineering Surakarta University, Jalan Raya Palur Km. 5 Surakarta, +62-274-825117, Indonesia

*Corresponding author, e-mail: dimas_s2te_12@mail.ugm.ac.id

Abstract

The digital library has the purpose of providing services to the user, therefore, user experience factor and adjusting the display device diversity becomes the main thing to consider in building a digital library. The digital library is visited by many users because it provides a lot of information so that the existing content should be accessible anywhere, anytime and using a variety of devices. This research focuses on the design of digital library interface that adapts to the user experience and a variety of devices. The method used in this study is testing the user experience for the evaluation of digital library interface and Responsive Web Design for the development of digital library interface. The confidence interval is used as the analysis of the test data. Implementation of the user experience and Responsive Web Design in the digital library interface design proposals can improve the estimated percentage of success and task time users.

Keywords: Digital Library, User Interface, User Experience, Responsive Web Design

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1. Introduction

The digital library has the ability to collaborate across the library that will increase the information resources faster and more complete [1]. Since digital libraries running on the Internet and users which varies from various backgrounds of psychological, educational and social uses of digital library services, it is necessary the best interface [2]. The main aim of the digital library is to provide services to users, so in building a digital library main thing to note is the user experience. The user experience is a method to improve the quality of user interaction for the user experience focused on understanding the user to know the needs of users, user capabilities and limitations which are owned by the user. Website layout design user interface digital library is one aspect to enhance the user experience [3].

Users can access their digital libraries are not only using a computer or laptop, but also using smartphones and tablets, and therefore the digital library should be optimized to be accessed using a variety of devices that can provide the best user experience [4]. Mobile device users to experience problems when accessing the digital library devoted to the desktop, as she often did scrolling and zooming to see information [5]. There are four methods of building a website to provide display solutions on mobile devices, including mobile-friendly, mobile-optimized, mobile apps and Responsive Web Design (RWD) [6].

Display user interface is expected to adjust to the device used by each user will have access website. Design user interface using RWD can be applied to provide the diversity of solutions, so as to provide ease and convenience to the users who will have access digital library website. Bohyun Kim [7] research on the implementation Responsive Web Design on several digital library interface. In the study explained that the design of the interface to include more content on the website is responsive making web pages to be very long when opened using a device with a small screen. Rumsey [8] implementing RWD on the library website academic health sciences University of Iowa. The research also noted that one of the challenges faced in implementing responsive design is to decide to do on the navigation menu at the top of the page using a dropdown menu that will make the space becomes wider web pages so that the content of the pages become more prominent.

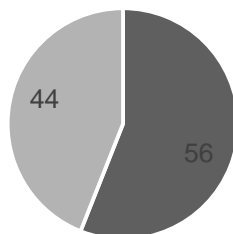
The method is often used by researchers in evaluating website interface library to determine the level of interface usability and problems encountered by users while using the library website is usability testing or usability testing. In the study conducted by Himma Dewiyana [9] stated that the use of formal interoperability testing method can provide results that North Sumatera University Library website can be used easily. Research using usability testing is also performed by Eru Mulya Pratama [10] states that, using the method of usability testing using a model SCANMIC that includes screen design, content, accessibility, navigation, media use, interactivity, consistency, yield the result that the website Library of the University of Atma Jaya Yogyakarta still problematic in navigation, consistency, content and accessibility. Purwani Istiana [11] evaluated the Gadjah Mada University Library website and Purwani Istiana and Eko Nugroho [12] evaluated the Library's website Faculty of Geography, University of Gadjah Mada. Research conducted gives the result that the effectiveness and efficiency factors significantly affect the usability of the library websites while satisfaction factors do not significantly affect the usability of the library websites.

The main focus of usability testing is successful the user in performing their duties and do not look at what is required by the user, so as to improve the quality of evaluation interface library website, then this research method used is the user experience. User experience methods will not only focus on user success in performing duties but also concerns the system functional factors in completing a job and the feelgood factor user based on affective component [13]. The Research contributions for this research is to deliver improving the quality of digital library interface with the adoption of user experience as the design and testing methods in the form of a digital library interface characteristics of the ideal college can provide references in building a digital library of college.

2. Research Method

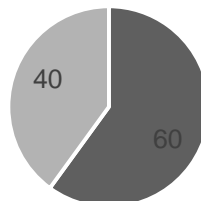
2.1. Research Partisipant

Testing in this research involved 100 students at the University of Surakarta. Selection of the characteristics of the participants included in the study had a background of age as seen in Figure 1, Internet access time, as seen in Figure 2, and the frequency of students looking for course materials on the internet as shown in Figure 3.



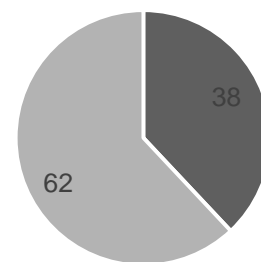
- 19 - 21 Years
- 22 - 24 Years

Figure 1. Age of Participants



- 1 - 2 Hours
- 2 - 4 Hours

Figure 2. Internet Access Time of Participants



- once or twice in a week
- several times in a week

Figure 3. The Frequency of Searching Online Material

2.2. Research Material

The tools used in the study consists of hardware and software. List of hardware as shown in Table 1 and the software used in research as seen in Table 2. The material used is a product comparison, test scenarios, and video recordings of testing. Comparative product analysis using digital libraries ten universities in the world and ten digital libraries of universities in Indonesia and two professional digital library. Selection of products for universities in the world based on the rank order version of the world's best universities Times Higher Education

World University years 2014-2015 and for universities in Indonesia based on the order of ranking list of the best universities Indonesia webometrics version updated in January 2015. Professional digital library that is used is Overdrive digital library and Safari Online.

Table 1. Hardware

No	Hardware
1	Notebook ASUS X450C, Prosesor : Intel Celeron 1,50 Ghz, Memory : 2 GB, Screen size : 14 Inchi, Screen resolution : 1366 x 768 pixels.
2	Smartphone Nokia XL, Prosesor : Dual-core 1 Ghz, Memory : 768 MB, Screen size : 5 Inchi, Screen resolution : 800 x 480 pixels.
3	Webcam Logitech C 170, Camera quality: 5 megapixels, Video Resolution : 640 x 480 pixels.

Table 2. Software

No	Software
1	Windows 8.0 Professional
2	Android 4.1
3	Software Webcam Logitech
4	Camtasia Studio 5
5	Bootstrap 3.0
6	Wordpress 4.4.1
7	Microsoft Office Excel 2013

2.3. Research Design

The initial step in the research is a comparative product analysis. Comparative product analysis results are used to determine the inventory of content and digital libraries comparator used as materials testing user experience. I data retrieval and analysis of data I by testing the user experience using digital libraries selected in the comparative analysis of comparative products, digital library is selected comparison website Gadjah Mada University's library and digital library Overdrive.

The data obtained in the data analysis I then used as input to create a prototype digital library. Evaluation of prototype digital library in step II data retrieval and data analysis II can be conducted if the digital library prototype testing had not found error. The last step taken is Comparative data between digital libraries and digital library prototype. For more avenues of research can be seen in Figure 4.

Testing the user experience using the 100 participants were divided into two groups with each group using 50 participants. One group did testing using a desktop device and one group perform testing using a mobile device, as shown in Figure 5. Testing the user experience using equipment specifications, bandwidth, and time of access as found in Table 4 and Table 5.

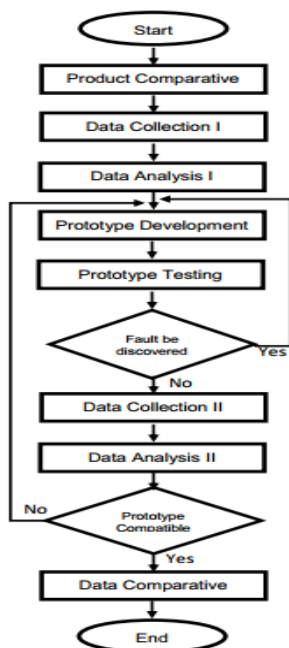


Figure 4. Research Design

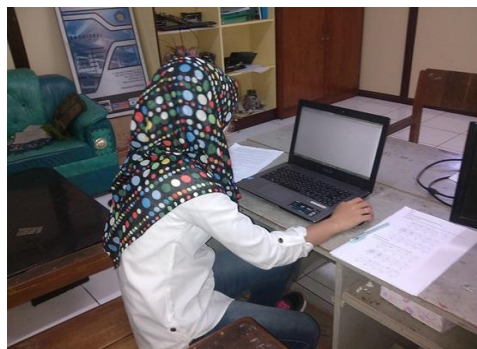


Figure 5. User Experience Testing

The test focused on the user experience simple search and advanced search in particular on the design of the search box. Implementation of the user experience testing is done by giving the assignment to users based scenarios to assess the success of the user in completing a given task. The data collected from testing the user experience is data that measure performance based on the attitude or behavior of participants that includes user success rate and time to complete the task.

Table 4. Testing On Desktop Device

No	Spesifikasi
1	Processor : Intel Celeron 1,5 Ghz – Intel Dual Core 3,3 Ghz
2	Memory : 2 GB – 4 GB
3	Screen size : 14 Inch – 16 Inch
4	Operating System : Windows 7 - Windows 8.1
5	Bandwidth : ADSL 1 Mbps – 2 Mbps
6	Time : 09.00 AM – 04.00 PM

Table 5. Testing On Mobile Device

No	Spesifikasi
1	Processor : Dual Core 1 Ghz – Dual Core 1,3 Ghz
2	Memory : 768 MB – 1 GB
3	Screen size : 4,5 Inch – 7 Inch
4	Operating System : Android 4.1 - Android 4.3
5	Bandwidth : Mobile 1 Mbps – 2 Mbps
6	Time : 09.00 AM – 04.00 PM

Analysis of the test in the search box digital library using confidence interval with a confidence level of 95%. Analysis of the confidence interval for task completion time (users who have successfully completed the task) using the adjusted-wald interval. The analysis was performed by calculating the percentage of participants who successfully complete the task well against the total number of participants who did the testing, analyzes were conducted to obtain the estimate (approximate) percentage success rate users when carrying out the same task. Equation adjusted-wald interval can be seen in equation (1). Analysis of the confidence interval for the time required by users who have successfully completed the task using the binomial distribution. The analysis is done by finding the median (middle value) of a list of participants who successfully complete the task, the analysis performed to obtain the estimate (estimate) the time required by the user while performing the same tasks. Binomial distribution equation can be seen in equation (4).

$$\hat{P}_{adj} \pm z_{(1-\frac{\alpha}{2})} \sqrt{\frac{\hat{P}_{adj}(1-\hat{P}_{adj})}{n_{adj}}} \quad (1)$$

Value \hat{P}_{adj} :

$$\hat{P}_{adj} = \frac{x + \frac{z^2}{2}}{n + z^2} \quad (2)$$

Value \hat{n}_{adj} .

$$\hat{n}_{adj} = n + z^2 \quad (3)$$

Where :

- x : the number of users who successfully carry out the task
- n : the number of test samples
- z : confidence level (95% use value 1,96)

$$np \pm z_{(1-\frac{\alpha}{2})} \sqrt{np(1-p)} \quad (4)$$

Where :

- n : the number of test samples
- p : persentil (median use value 0,5)
- $z_{(1-\frac{\alpha}{2})}$: confidence level (95% use value 1,96)
- $\sqrt{np(1-p)}$: standard error

3. Results and Discussion

Results and discussion is divided into three parts: the user experience testing, prototype manufacture digital libraries, and analysis of test results between product comparison with the prototype digital library digital library.

3.1. User Experience Testing

Based on the results of tests on the library website UGM and digital libraries Overdrive can be concluded that most participants did not mengalami trouble when doing a simple search (simple search) using desktop and mobile devices, compared with a simple search (simple search) participants experience any difficulties when making testing specific search (advanced search) especially when participants performed the test using a mobile device.

The problems with usability testing were found in testing the user experience website UGM library and digital library Overdrive is a participant does not see or do not know a more detailed search key that has been provided on the library website UGM, as seen in Figure 6. The tests performed on the user's mobile most participants were having difficulty finding a search box for Overdrive using the magnifying glass as a metaphor for the search box, as shown in Figure 7.

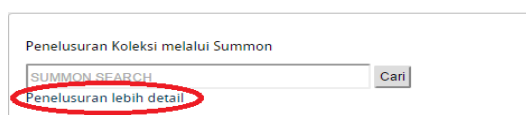


Figure 6. Search Box On UGM Library Website



Figure 7. Search Box Overdrive Digital Library

3.2. The Development Prototype of Digital Library

Content inventory is done to determine the priority of the content that will be used in the digital library proposal. The main focus on the implementation of RWD precedence on the display of mobile devices, because the screen size of mobile devices is limited to the amount of content that can be displayed is also limited. Reference content to be used on digital library proposal, as presented in Table 6. The data obtained in subsequent reference content used as an ingredient for the manufacture of prototype digital library proposal as shown in Figure 9 and Figure 10. The digital library has a lot of content and to optimize the display of specific content on the smartphone device with limited screen size, the prototype of the digital library using a form responsive tab as shown in Figure 11. The search box prototype digital library using a model tab as shown in Figure 12.

Table 6. Content Reference

No	Content
1	Name and logo
2	Profile
3	Using Library
4	Help
5	User Account
6	Research resource
7	Collection
8	Search Box
9	Library Service Hours
10	Library Service
11	News update
12	Activity update
13	Library Address
14	Contact and call us
15	Social media

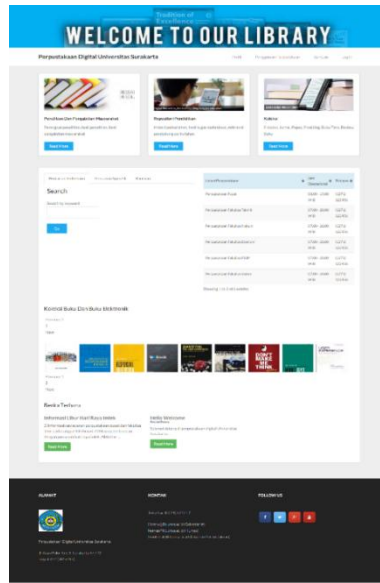


Figure 9. Prototype of Digital Library

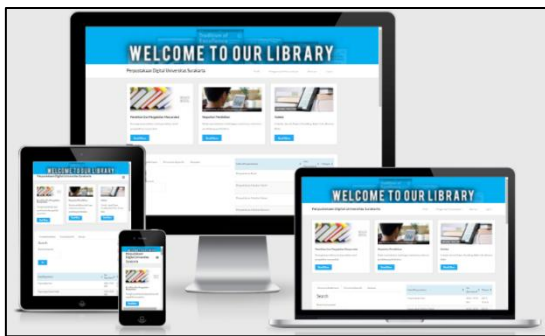


Figure 10. Prototype of Digital Library On Various Device

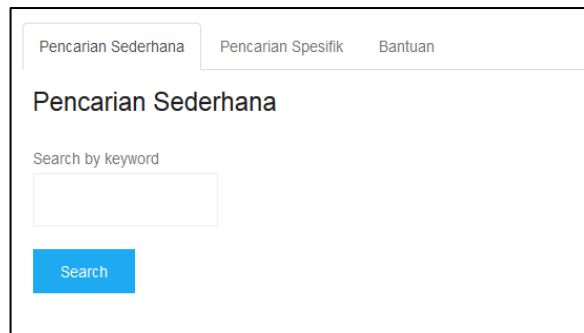


Figure 11. Search Box Prototype of Digital Library

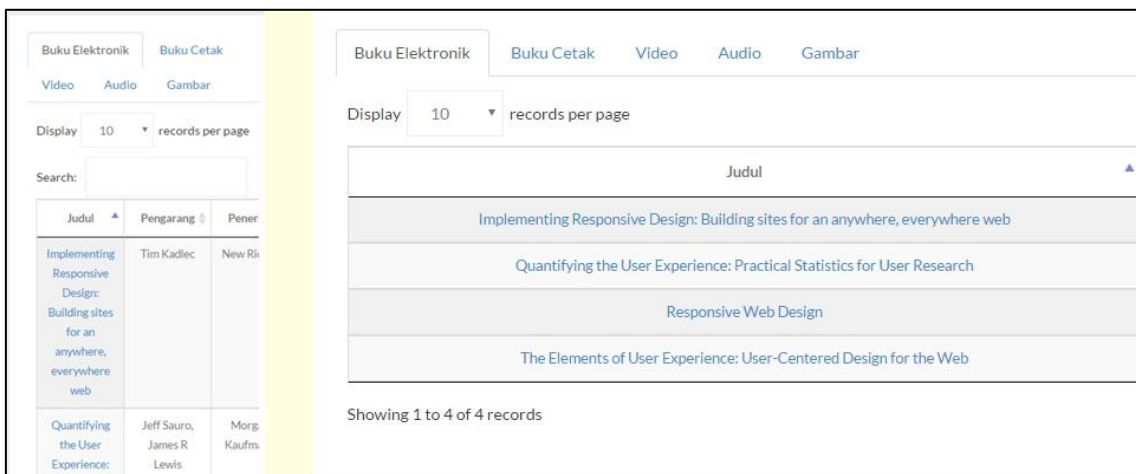


Figure 12. Responsive Tabs On Prototype of Digital Library Views On Mobile Device and Desktop Device

3.2. Test Results Analysis

Information shown in Table 7 and Table 8 is a digital library of information on test results comparison and prototype digital library using mobile devices and desktop device number. Data shown is composed of a number of users of successful and failed to complete the task, the estimated percentage of users' success, and the estimated task time users. Implementation using the search box on the tab form a prototype digital library is able to increase the percentage of successful users and task time users to search specifically on specific searches.

Table 7. Testing Results On Desktop Device

UGM Website Library				
Testing Scenario	Success	Failed	Estimated Percentage of Success	Estimated of Task Time
Simple Search	44	6	85 ± 9 %	109 ± 3 second
Advanced Search	33	17	64 ± 12 %	189 ± 6 second
Overdrive Digital Library				
Testing Scenario	Success	Failed	Estimated Percentage of Success	Estimated of Task Time
Simple Search	43	7	83 ± 9 %	136 ± 9 second
Advanced Search	30	20	59 ± 13 %	194 ± 5 second
Prototype of Digital Library				
Testing Scenario	Success	Failed	Estimated Percentage of Success	Estimated of Task Time
Simple Search	43	7	83 ± 9 %	109 ± 6 second
Advanced Search	38	12	74 ± 11 %	132 ± 4 second

Table 8. Testing Results On Mobile Device

UGM Website Library				
Testing Scenario	Success	Failed	Estimated Percentage of Success	Estimated of Task Time
Simple Search	42	8	81 ± 11 %	141 ± 3 second
Advanced Search	22	28	44 ± 13 %	231 ± 4 second
Overdrive Digital Library				
Testing Scenario	Success	Failed	Estimated Percentage of Success	Estimated of Task Time
Simple Search	38	12	74 ± 11 %	190 ± 12 second
Advanced Search	20	30	40 ± 13 %	226 ± 14 second
Prototype of Digital Library				
Testing Scenario	Success	Failed	Estimated Percentage of Success	Estimated of Task Time
Simple Search	41	9	79 ± 10 %	154 ± 6 second
Advanced Search	34	16	66 ± 12 %	179 ± 3 second

4. Conclusion

The conclusion of this research are:

1. Implementation of the user experience and Responsive Web Design in the digital library interface design proposals can improve the estimated percentage of success and estimated task time, especially on a specific search. Specific searches using desktop devices increased by 74 ± 11% and the use of mobile devices has increased by 66 ± 12%, while the task time specific searches using desktop devices faster and 132 ± 4 seconds and use mobile devices more quickly to 179 ± 3 seconds.

2. Criteria ideal digital library of college is to have the facility user account, the profile library, contacts, search boxes, collections, research support, learning support, library services, news and the latest activities, libraries and service hours, address, phone number, and social media. Implementation tab in the search box and digital libraries are able to optimize content search and view content on mobile devices with limited screen size. Subsequent research suggested adding other measurements such as the number of clicks and the number of errors to better know the quality of user experience.

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